UNIVERSITY OF ARIZONA
39001007204863

JOHN M. EVVARD

Arizona
University
Library

Presented by
John M. Evvard
1949

JOHN M. EVVARD

BIRDS

IN THEIR

RELATIONS TO MAN

Digitized by the Internet Archive
in 2025

https://archive.org/details/bwb_S0-EKS-958

THE BLUE YELLOW-BACKED WARBLER.

BIRDS

IN THEIR

RELATIONS TO MAN

A Manual of Economic Ornithology for the United States and Canada

BY

CLARENCE M. WEED, D.Sc.

PROFESSOR OF ZOOLOGY AND ENTOMOLOGY, NEW HAMPSHIRE COLLEGE OF AGRICULTURE AND THE MECHANIC ARTS

AND

NED DEARBORN, D.Sc.

ASSISTANT CURATOR, DEPARTMENT OF BIRDS, FIELD COLUMBIAN MUSEUM, CHICAGO

ILLUSTRATED

PHILADELPHIA AND LONDON

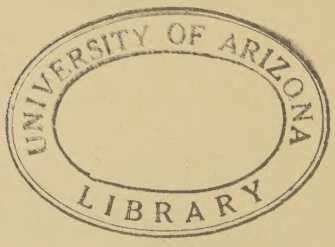
J. B. LIPPINCOTT COMPANY

1912

Copyright, 1903

by

Clarence M. Weed and Ned Dearborn



Electrotyped and Printed by

J. B. Lippincott Company, Philadelphia, U. S. A.

TO

STEPHEN ALFRED FORBES

DIRECTOR OF THE ILLINOIS STATE
LABORATORY OF NATURAL HISTORY

WHOSE CLASSIC STUDIES OF THE ECONOMIC
RELATIONS OF BIRDS WILL LONG
REMAIN THE MODEL FOR
LATER STUDENTS

This Book

IS GRATEFULLY INSCRIBED

223301

CONTENTS

CHAPTER		PAGE
	INTRODUCTION.—THE RELATIONS OF BIRDS TO MAN	1
I.	THE METHODS OF STUDYING THE FOOD OF BIRDS	9
II.	THE DEVELOPMENT OF ECONOMIC ORNITHOLOGY	17
III.	THE VEGETABLE FOOD OF BIRDS	27
IV.	THE ANIMAL FOOD OF BIRDS	42
V.	THE AMOUNT OF FOOD CONSUMED BY BIRDS	59
VI.	BIRDS AS REGULATORS OF OUTBREAKS OF INJURIOUS ANIMALS	68
VII.	THE RELATIONS OF BIRDS TO PREDACEOUS AND PARASITIC INSECTS	81
VIII.	THE THRUSHES AND THEIR ALLIES	86
IX.	THE NUTHATCHES, TITMICE, CREEPERS, AND WRENS	105
X.	THE WARBLERS AND THE VIREOS	112
XI.	THE SHRIKES, WAXWINGS, SWALLOWS, AND TANAGERS	122
XII.	THE FINCHES AND SPARROWS	132
XIII.	THE ENGLISH SPARROW	144
XIV.	THE ORIOLES, BLACKBIRDS, CROWS, AND JAYS	156
XV.	THE FLYCATCHERS, HUMMING-BIRDS, SWIFTS, AND NIGHTHAWKS	174
XVI.	THE WOODPECKERS, KINGFISHERS, AND CUCKOOS	181
XVII.	THE OWLS	195
XVIII.	THE HAWKS, EAGLES, KITES, AND VULTURES	205
XIX.	THE PIGEONS, GROUSE, AND SHORE-BIRDS	219
XX.	THE WATER-BIRDS	239

CHAPTER PAGE

XXI.—The Conservation of Birds.—I. The Non-Game-Birds . 255

XXII.—The Conservation of Birds.—II. The Game-Birds . . . 271

XXIII.—Preventing the Depredations of Birds 293

XXIV.—Encouraging the Presence of Birds 304

APPENDIX

I.—The Bird Law of the American Ornithologists' Union 317

II.—The Lacey Bird Law 320

III.—Some Fundamental Principles of Bird Laws 323

IV.—A Partial Bibliography of the Economic Relations of North American Birds 326

Index 375

THE RELATIONS OF BIRDS AND INSECTS ON A NEW HAMPSHIRE FARM.

BIRDS

IN THEIR

RELATIONS TO MAN

Introduction.

THE RELATIONS OF BIRDS TO MAN.

The town of Durham, New Hampshire, in which this book has been written, may serve to illustrate in miniature the relations that exist between the world of birds and the world of man. This town abounds with homesteads distributed over its more habitable portions, with considerable areas of woodland and rocky pastures, while on the east it adjoins that arm of the sea called Great Bay. Running into this bay is the Oyster River: below the dam which holds back the fresh water this is a tide-stream, overflowing salt marshes through part of its course. As a result of this unusual situation, Durham has an extraordinarily rich fauna and flora, making the region one to delight the heart of the naturalist.

During the summer season birds are abundant in this town. In the yards about the houses the chipping-sparrows are cherished dwellers, building their horse-hair nests under the very windows, and supervising the lawns and roadways for grasshoppers, caterpillars, and many other insects found among the grasses and low herbage. The robins are also abundant, running over the lawns in search of earthworms, cutworms, and grasshoppers, often building their nests in the trees in the yard, though more commonly repairing to the

near-by orchard for that purpose. The bluebirds feed more freely upon low-living insects than even the robins do, eating great numbers of cutworms and similar pests about the borders of the garden, as well as searching for insects in the fruit and shade trees. Farther afield this area next the ground is supervised by various other birds: in the pastures and grass-lands sparrows, meadow-larks, bobolinks, blackbirds, and quails are always searching for caterpillars and other insects; along the borders of the forests chewinks and brown thrashers scratch beneath the shrubbery for such insect fare as is there available; in the deeper woods the ruffed grouse is similarly engaged, while along the margins of ponds and streams the sand-pipers, plovers, woodcock, and snipe are always probing for hidden tidbits.

FEMALE RED-WINGED BLACKBIRD.

Fortunately, trees are abundant in Durham: near the houses and along the streets shade and ornamental trees abound; in the orchards apple-trees prevail; along the water-courses alders and other shrubby trees hold sway, while in the forests oak and maple and beech and stately pines are everywhere. All of these trees have their insect enemies: in the trunk are borers of the bark, the sap-wood and the heart-wood; on the branches are gnawing and sucking insects; on the leaves are caterpillars and plant-lice and leaf-hoppers and hosts of others. Set over against these destroyers are many feathered enemies: the woodpeckers, assisted by the nut-

hatches and creepers, look after the insects on and beneath the bark of both the trunk and branches; the chickadees and warblers and vireos and kinglets are always scrutinizing the leaves for their inhabitants, and are assisted in the case of the caterpillars and larger insects by the bluebirds, thrushes, cherry-birds, and many others.

The air is no less thoroughly supervised by our feathered allies than are the grasses and the trees. Most insects at one stage of their existence are aerial: by day the butterflies, the beetles, some of the moths, the grasshoppers, the hosts of two-winged flies, and many others are upon the wing; while by night an even greater host of moths, fire-flies and other beetles, bugs, and many other insects are abroad. To keep in check these hordes of flying things there are certain well-marked groups of birds: by day the swallows of many species and the chimney-swifts are constantly patrolling the larger spaces of the air, over both land and water, capturing millions of these aerial insects; the kingbird, pewee, and other fly-catchers, as well as to a more limited degree the cedar-bird and bluebird, capture the insects that pass within their range of vision as they perch upon fence or stump or tree; the warblers and vireos catch those insects flying in the immediate vicinity of the green-leaved trees, while the redstarts have well been named the fly-catchers of the inner tree-tops; by night the nighthawks and whip-

THE KINGBIRD.

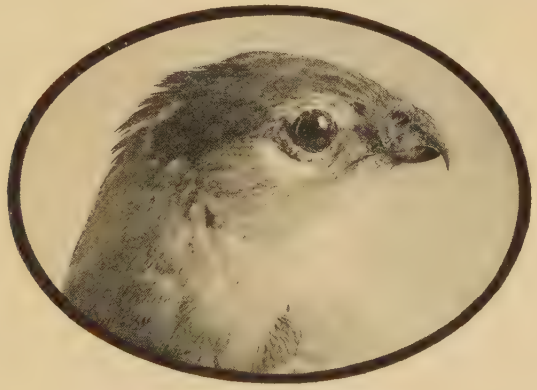
poorwills are rushing everywhere through the air catching in their capacious maws insects of all sorts and sizes. With all these birds to devour them, it is evident that the insects of the air are well provided against, if we will only encourage our aerial friends as they deserve.

THE YELLOW WARBLER.

But insects are not the only pests troublesome upon our farms. In and about the barns and outbuildings mice and rats do much damage to grains, eggs, and poultry; in the grass-fields moles and meadow-mice are sometimes injurious; in the orchards rabbits often girdle young trees by gnawing the bark. Against these also the birds help us: the hawks and owls feed largely upon all these rodents, and perform a great though little appreciated service in keeping them in check.

After many years of study, in New Hampshire as well as many other States, of these relations of birds to agriculture, we are convinced that the birds are a most potent factor in making crop production possible, that without them we should be overrun with pests—vertebrate and invertebrate—to an extent of which we now have no conception. And so we are disposed to be lenient towards the few shortcomings of the birds which loom so large to many who see only one side of the picture. Fruit is pilfered by some of the birds, though in our region so few cherries and small fruits are raised and there is relatively so much wild fruit that the loss is of small

account. In orchards near the woods a few trees are often disbudded in winter by ruffed grouse, and some other trees are treated in a similar way occasionally when the pine grosbeaks visit us. In corn-fields some corn is pulled up by crows, though our farmers prevent this largely by various means, and from us at least find no objection when they are able to shoot these wily thieves. And the same is true in the case of the yellow-bellied sap-sucker when it is girdling a tree, if only the owner will not extend his hatred to the woodpeckers that resemble it,—the downy and the hairy,—which are so eminently useful. In England some birds are



HEAD OF HAWK.

put on the black-list because they feed upon fish, but with us this is never thought of. We are sure the kingfisher is not begrudged his scaly diet by any one who is able to appreciate the fitness of the bird to our river scenery. And we can well spare the few fish our ospreys catch in the waters of the bay, when we are rewarded by the sight of the stately birds soaring through the air. About the only bird offence we are unable to condone is the robbing of our poultry-yards by the hawks and owls; and here, unfortunately, the inoffensive species generally have to pay the penalty for the crimes of their more ferocious kindred.

As to the relations between the birds themselves—especially the few that prey upon their kindred—in general we are content to let Nature work out her balance of life in her own

HEAD OF SHRIKE.

way. The chief exception to this under our present conditions would be in the notable case where short-sighted man has interfered with Nature's balance by introducing the English sparrow, which, we regret to say, is becoming well established in our town. And we have the same feeling with regard to those parasitic and predaceous insects which birds undoubtedly devour: we are quite sure that by so doing they are helping to keep the balance of insect life where it will be most effective for man's benefit.

The birds are also to be credited with the destruction of an enormous amount of weed-seed, a service which is little appreciated by the general public. The estimate by Professor F. E. L. Beal, that the tree-sparrows alone will eat eight hundred and seventy-five tons of weed-seed in Iowa in one season, should help to a more general appreciation of this phase of bird activity.

There are various other benefits derived from birds which are not illustrated in our local conditions. One such is the

supplying us with down by the eider-ducks; another, the scavenger value of buzzards and vultures in our Southern States, as well as of gulls in the harbors of our cities; and yet another, the indication of shoals of fish by the presence of gulls, as along our Atlantic coast.

Next in importance to the direct economic value of this bird life to our towns-people should be considered its value as an object of study and interesting recreation. Many people find in the birds a subject of constant interest in which they are kept out-of-doors in the health-giving atmosphere of our coastal region, finding always something to occupy and tranquillize the mind. With the modern devices for such study, —the splendid field-glasses, the improved long-distance cameras, the tents for close-range observations,—together with the constantly increasing number who are being attracted to it through the schools and the fascinating bird-books of later years, the class of people who thus find in the observation of bird-life a delightful pastime is certain to increase rapidly.

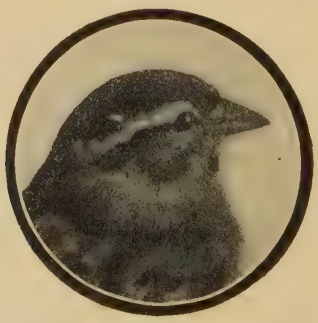
And there are many people with no special liking for natural history studies who yet appreciate the value of birds in ministering to man's love of beauty. To these the sight of a brilliant humming-bird poised before a flower, of a yellow warbler among the apple-blossoms, or of a splendid heron beside the rippling waters is a memory to be cherished certainly as much as the sight of a great masterpiece of painting or sculpture created by human genius.

There is also another relation the birds of Durham bear to its human inhabitants. In the woods everywhere ruffed grouse are plentiful; in the low swales woodcock, and in the wet meadows Wilson's snipe are not uncommon; along the bay shores and by the marshes plover of various sorts are often found; on the waters of the bay wild ducks and wild geese are abundant during the fall migration. All of these birds afford those inhabitants who enjoy legitimate sport an opportunity for invigorating days of hunting, as well as a cer-

tain amount of excellent food. This game might also easily become a source of revenue to many other people in the town by attracting city visitors for the shooting season.

In the following pages we have attempted to discuss in a broad yet specific way the relations of birds to man as illustrated in temperate North America. The book has been made possible only through the labors of such investigators as Forbes, Merriam, Beal, Barrows, Fisher, Palmer, Judd, Warren, Herrick, Montgomery, and many others, upon whose published results we have freely drawn. The need of the book was first shown when the senior author undertook to teach a college class the subject of economic ornithology, and its first draft consisted of the lectures prepared for that class. When later the junior author—a life-long student of birds—became associated with him, a joint study of the whole subject was undertaken, the results of which are here presented.

A considerable proportion of the illustrations in this book are from original photographs—chiefly of mounted specimens—by the authors. The others have been gleaned from various sources, which are credited beneath the pictures.



HEAD OF CHIPPING-SPARROW.

Photographed from life by Dr. R. W. Shufeldt.

THE KINGBIRD.

CHAPTER I.

THE METHODS OF STUDYING THE FOOD OF BIRDS.

The accurate determination of the feeding habits of birds must form the foundation of any adequate knowledge of their economic status. To determine these habits two principal methods are available: (1) the birds may be watched in their natural haunts and the food they take be observed as carefully as possible; (2) the birds may be killed and the food found in their alimentary canals examined to determine its nature. A third method, that of observing the food preferences of birds in captivity, is chiefly valuable in helping to determine the amount of food eaten by birds, although considerable information may thus be obtained also regarding their choice of food.

The first of these methods may be readily employed in determining the varieties of vegetable food that adult birds eat, and in exceptional cases is of value in determining the animal food of such birds. It is of greatest value, however, when applied to the nestlings, especially in the modification of the method first successfully employed by Professor F. H. Herrick, and described in detail later in this chapter.

To the majority who would learn at first hand *what* birds eat, field-work is the only sort that appeals. Only those with the genuine scientific spirit are willing to soil their fingers with dissection or to spend hours in identifying the contents of a single stomach, even though possessed of sufficient experience to carry on such an investigation. Even in field-work an extensive knowledge of animals and plants is necessary if one would name half the objects he sees in birds' bills. But while it is highly desirable to ascertain exactly what birds eat, it by no means follows that a person should wait until he has

mastered botany, entomology, and kindred subjects, that will enter into his researches, before attempting to learn at least the general character of the food eaten by our various birds. To know whether a bird prefers insects or seeds is worth while, though the name of the insect or seed consumed may be beyond guessing at. The main thing, after all, in field-work, is to keep an attentive eye on the birds, to learn how to observe without frightening them, and to know when and where the different species feed.

The study of food habits is not usually begun until after the student has gained a fair understanding of other habits that are more attractive to watch and oftener dwelt upon by ornithological writers. It is a sort of post-graduate course, so to speak,—another field into which the enthusiast, after covering the old run of species, distribution, migration, nests, eggs, etc., may enter if his enthusiasm holds out. Therefore it is taken for granted that whoever is inclined to investigate the food of birds is equal to his undertaking from the bird side, if no more. What he may not know about the items of food in the beginning, he will become so anxious to find out that his stock of information will rapidly increase. If one is interested in birds, the food problem will afford a good "handle" for picking up an interest in other branches of natural history.

For examining adult birds in the field, good vision and a note-book and pencil are the chief requisites, though an opera- or field-glass may often be used to advantage. Warblers, vireos, and other active birds that live by foraging may be quietly followed as they flit from tree to tree. In this way it is not difficult to discover the character of their food and about how much is consumed during a given interval of time. Now and then there will be favorable moments when it is possible to see for a certainty just what is taken. Cuckoos, kingfishers, flycatchers, and other birds that are more or less sedentary must be watched, an hour or two

perhaps, from one position,—an occupation not nearly so irksome as it looks on paper.

Wherever an abundance of some particular kind of food occurs, it is a good plan to sit down where you can see without being seen and wait for visitors. In this case your notes will take on a different look. Instead of having a bird's name at the head and a list of food items beneath, you will have a food name at the top and the names of birds that partake in the columns below. Thus, you may sit on the shore and see what birds live on fish and what on mollusks. You may stroll across the fields at haying time and discover the birds that feed on the myriads of leaf-hoppers, grasshoppers, and "millers" that take to wing at every step. So may you learn what birds are addicted to any seed or fruit that you may bring under observation. It is well to note in passing that birds are excellent judges of quality in fruits, for which reason it is well to see "which way the birds fly" before selecting a site for operations.

In the laboratory birds may be kept alive and tested as to their preferences for different kinds of food, though such experiments are not likely to be very satisfactory, for the reason that birds in captivity quickly learn to relish things they would never taste in the wild state.

A knowledge of the amount of food eaten by caged birds is of value, however, as whatever difference there may be between the quantity consumed in the wild and in the captive state is on the safe side. A prisoner cannot dispose of so much as the activity of a free bird demands.

The determination of bird food by dissection requires an extensive outfit, if it is thoroughly done. There must be at hand good collections of botanical specimens, including seeds; of insects, mollusks, fish, frogs, reptiles, birds, and small mammals,—everything, in short, likely to be eaten by a bird,—in order to name correctly the visceral contents. Even the bones of the smaller vertebrates will be necessary for identi-

fying the food of hawks and owls. A simple magnifier will be needed constantly and at times there will be use for a compound microscope.

Instead of examining each bird at the time of its capture, it is usually more convenient to remove the digestive tract, and, after attaching a numbered tag by means of thread, to put it into a jar of five per cent. formalin or eighty per cent. alcohol, where it may safely remain until enough have accumulated for a day's work. Viscera may be kept indefinitely if the preservative fluid is changed as often as it becomes discolored. The number on the tag corresponds to one in the note-book, where are recorded the name of the bird, the date and place of capture, and any other data that may have a bearing on diet.

When ready for the analysis, a stomach may be cut open with a pair of scissors or a scalpel, and the contents emptied, with a little water, on a piece of plain glass,—say, three by three inches, for any bird smaller than a flicker. If a dissecting microscope be available, the magnifier may be managed more easily, and, furthermore, transmitted light or reflected light with a black or white background may be used at will. With a pair of sharp needles set in handles the mass may be spread over the glass and assorted. Wings of insects may be unrolled and floated on the film of water so as to be identified as to family and often as to genus. By assembling the parts of insects or other food of the same kind into little piles, the relative amount of each may be estimated.

Hawks, owls, crows, flycatchers, and certain other birds that devour indigestible matter, such as bones, the elytra of beetles, etc., regurgitate such matter in the form of compact pellets, generally at the roosting places.[1] Insectivorous and

[1] See The Common Crow, Bull. No. 6, U. S. Dept. of Agr., Div. Orn. and Mam.; also Montgomery on the Food of Owls, Am. Nat., July, 1899, vol. xxxiii. pp. 563–572.

BOBOLINK APPROACHING NEST IN PAIL.

NEARER HOME.

fruit-eating birds do not digest their food so thoroughly but that its nature is apparent from the excreta. Wherever birds roost in numbers, pellets or excreta or both may be gathered, and when analyzed will give results scarcely less valuable than those obtained by dissection, with the advantage that there is no sacrifice of bird life.

A study of the food of nestlings is less difficult and on the whole more satisfactory. Both the kind and the quantity

READY TO FEED.

may be accurately determined without injuring so much as a feather.

If the nest is on or near the ground, a small neutral-colored tent may be set up beside it as near as you please, into which you may retire, and, by watching the progress of affairs through a small "peep-hole," fill your note-book with an account of the rations that are consumed. If on the ground the nest and young may be transferred to a sunken pail for better observation, as shown in the bobolink photographs herewith. It usually happens, however, that the nest is not in a position

where a tent can be placed beside it. In that case locate the tent in a good place as near by as may be, and then cut off the branch, fasten it strongly to a support by cords or screws, and by degrees move it to a place beside the tent.

When it is not necessary to remove the nest, the tent may be pitched as early as the day of hatching, in most cases at least, without fear of causing the old birds to desert. But when the nest has to be moved, unless the degrees of progress are made very short, there is danger of desertion if the moving is undertaken before the young are well covered with starting pinfeathers. Then they are able to move about and usually

OUTFIT FOR PHOTOGRAPHING BIRDS IN NEST.

to make sounds that attract the parent birds. At that time also parental devotion is at its full strength, and the old birds are willing to face dangers that they would not otherwise encounter.[1]

Where a nest is to be moved and there is not much danger of being bothered by prowling boys, we usually employ a fairly good-sized tent, as it gives the observer a chance to change his position without giving external evidence of it.

---

[1] This method of controlling the nest and using a tent for concealment was first described in "The Home Life of Wild Birds," by Professor F. H. Herrick, which see.

It is set up early, so the birds may get accustomed to seeing it, and not taken down till the observation is completed. Sometimes several nests are brought one after another to the same site. In the illustration opposite there is a chipping-sparrow's nest in position and a robin's in waiting only ten feet away. Except for the trouble and a very slight delay in the work of the birds, there is no objection to striking the tent every evening and pitching it again in the morning.

At such short range there is generally no doubt as to the identity of every object that is brought to the nest. Some birds bring food in their gullets and feed by regurgitation. If it is not possible to see what they are delivering, wait till the old one has gone away, then go out and examine the young. Four times out of five you can tell what they have swallowed by looking through the transparent skin of their necks. In case there is still a doubt, it is not difficult to make them disgorge by placing a thumb and finger below the mass and working it upward to the mouth. Simple honesty demands that it be returned when you are done with it.

See how many hours a day the old birds attend their young and how many times they average to feed per hour. Estimate the proportion of each kind of food from an examination of your notes. Then by weighing samples of the different kinds you can quickly compute the daily consumption.

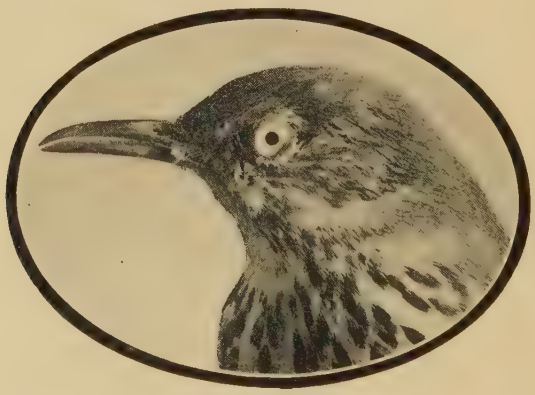
As a check on the above method weigh the young at the same hour every day. Collect several excreta and find the average weight, also observe the average number voided per hour. The weight of excrement for the day plus the bird's gain in weight for the day will give the weight of food consumed, less the small amount lost by respiration.

The excreta of young birds is so well wrapped in a coat of albumen that it is not so objectionable to handle as might be supposed. It may be obtained at any time by taking the bird from the nest and keeping it out for a few minutes.

In order to distinguish one nestling from another they may

be marked either on the leg or on the side of the bill with a nitrate of silver pencil, which may be purchased at any drug store. There may be some difficulty in applying the pencil so as to make a good mark, owing to the oily skin of the birds, but see that it is wet and keep rubbing. The marks will need to be renewed occasionally.

The great value of this method is that it enables one to get photographs of the birds as they are being fed, beautiful examples of which are shown in Professor Herrick's book. There are, however, elements of danger to the birds, which should by no means be overlooked. There is danger of desertion by the parents, of too much exposure to the hot rays of the sun, of lack of protection from the cold of night or of the storm and stress of weather, as well as of various living enemies. No one should remove a nest from its original site who is not willing to take every possible precaution to avoid a tragedy.



HEAD OF BROWN THRASHER.

THE BARN-OWL AND ITS PREY.

(After United States Division of Biological Survey.)

CHAPTER II.

THE DEVELOPMENT OF ECONOMIC ORNITHOLOGY.

When Columbus was making that eventful voyage which led to the discovery of the New World, he was cheered by the sight of small birds that appeared beside his ship, telling him of his approach to land. And ever since then these children of the air have been of interest to the white people who have come to America, as they had been for untold ages before to the red men who roamed over the continent. The early New England settlers were troubled by some birds against which they declared war, and cheered by others to which they extended the offerings of friendship. And even in those early days there were some men who found in the study of birds a source of delight to which they gladly gave their time. It is nearly two centuries since Mark Catesby wandered through the wilds of Florida and Carolina, seeking out the birds and other animals of those unexplored regions, the publication of his results having been begun in 1731. Towards the end of the eighteenth century there were many workers in the field, the most prominent being Bartram, Latham, and Barton. And before the end of that century Alexander Wilson came over from Scotland to begin those pedler journeys during which he became interested in American birds.

At the opening of the nineteenth century Wilson was greatly interested in our bird life, and as early as 1808 began the publication of his splendid volumes on American Ornithology. As Dr. T. S. Palmer has well said,—in an admirable paper,[1] of

[1] A Review of Economic Ornithology, Yearbook, Dept. Agr., 1899, pp. 259–292.

part of which the present chapter is necessarily a poor parallel, —this work of Wilson's laid the true foundation of ornithology in the United States. And it contained many references to the purely economic phases of bird life, showing again and again the value of different species as destroyers of insects. Before the century had run its first quarter the great Audubon was exploring the wilderness in all directions, making wonderful paintings of its bird inhabitants and drawing up excellent accounts of their ways and habits. The publication of his work began in 1827 and continued till 1839. He also made many references to feeding habits and economic values, as did Nuttall, whose volumes, published from 1832 to 1834, were largely based on the works of these two earlier naturalists.

From 1850 onward the technical science of ornithology made wonderful strides, which it is no part of our present purpose to describe. But about this date various persons interested in agriculture began to see the value of birds as insect destroyers, realizing that the unchecked destruction of these feathered allies was leading to an alarming increase of insect pests. The agricultural journals and the reports of agricultural and horticultural societies began to publish many excellent articles, which showed careful observations and thoughtful consideration of the relation of birds to crop production. The titles of most of these papers will be found in the bibliography at the end of this book, so that there is no need for specific mention here. One by Wilson Flagg, however, published in the Report on the Agriculture of Massachusetts for 1861, is so remarkable that we cannot pass it by. It is entitled "The Utility of Birds," and is a general survey of the field which would do honor to a man to-day, after all the intervening years of study and discovery. It is based on the thesis distinctly stated in these words, which are italicized in the original article,—*that each species of bird performs certain services in the economy of nature, which cannot be so well accomplished by any other species.* This paper was

printed shortly after the publication of a remarkable article by Professor J. W. P. Jenks, in which an elaborate study of the food of the robin was recorded. In this study the modern method of examining the contents of the alimentary tract and estimating the ratios of the food elements found was employed, apparently for the first time in any elaborate way. During the same year (1858) that Professor Jenks was making his investigations, another Massachusetts man, Professor D. Treadwell, made some remarkable observations upon the amount of food required by young robins, the results of which have often been quoted.

During the decade from 1860 to 1870 there was a great deal of discussion regarding the influence of birds upon agriculture. The transactions of the various agricultural and horticultural societies and the agricultural, horticultural, and entomological journals of this period contain frequent references to the subject. The statement by Dr. B. D. Walsh, the first State Entomologist of Illinois, that birds were of doubtful value because of the parasitic insects they devoured, led to much comment; this statement is discussed in Chapter VII. of the present work.

It was during this period that Professor Samuel Aughey, of Nebraska, began his remarkable investigation of the relations of birds to outbreaks of Rocky Mountain locusts, the results of which are summarized in Chapter VI. herewith. These observations were not published, however, until near the close of the next decade,—1878. This was the most important study of the subject carried on during the decade from 1870 to 1880, although before the close of this period Professor S. A. Forbes, State Entomologist of Illinois and Director of the Illinois State Laboratory of Natural History, had begun the studies on which the classic papers published during the next decade were based. During the early years of the next decade Professor Forbes published several papers which may fairly be said to furnish the basis for the modern development

of economic ornithology. The most important of these have the following titles: "The Food of Birds" (1880); "On some Interactions of Organisms" (1880); "Notes on Insectivorous Coleoptera" (1880); "The Food Relations of the Carabidæ and the Coccinellidæ" (1883); "The Regulative Action of Birds upon Insect Oscillations" (1883). These papers, by one of the most scholarly naturalists America has ever known, were as remarkable for their philosophic breadth of view as they were for the care with which the last detail was followed out. On the whole they still remain the most satisfactory papers upon economic ornithology that have been published.

In 1882 Professor F. H. King, of Wisconsin, published an elaborate paper on the "Economic Relations of Wisconsin Birds," and in 1886 Dr. B. H. Warren published a report upon the "Birds of Pennsylvania." Each of these contained the results of many studies of bird food and was an important contribution to economic ornithology.

During the latter half of that decade the subject of economic ornithology was taken up by the United States Department of Agriculture, and the story of the development of the subject since that time has been chiefly the story of the operations of the Division of Biological Survey. This work has been so well summarized by Dr. T. S. Palmer, Assistant Chief of the Survey, that we quote from his paper at considerable length.

"One of the most important results of the organization of the American Ornithologists' Union was the impetus given to the study of economic ornithology. Committees on the English sparrow, bird migration, and geographical distribution were appointed at the first meeting, and elaborate investigations were at once begun. The work, however, had been planned on such a large scale that it soon outgrew the resources of the committees, and at the second annual meeting of the union it was determined to present a memorial to Congress to secure an appropriation for continuing it. The

relation of birds to agriculture is so intricate and the thorough study of their food so difficult, on account of the amount of time and material required, that investigations of this kind are ordinarily beyond the means of private individuals and are entitled to government support. In recognition of the importance of the work, Congress granted an appropriation of five thousand dollars, to be expended under the Division of Entomology of the Department of Agriculture, and on July 1, 1885, established a section of economic ornithology. Under the direction of Dr. C. Hart Merriam, investigations were outlined on a broad scale, to include the 'food habits, distribution, and migration of North American birds and mammals in relation to agriculture, horticulture, and forestry.' A year later the section became an independent Division, and in 1896 its name was changed by Congress to the broader title of Division of Biological Survey.

"FIRST PUBLICATIONS OF THE DIVISION.

"Upon the organization of the Division of Ornithology and Mammalogy, the data collected by several of the committees of the American Ornithologists' Union were turned over to it and formed the basis of its first two bulletins. The notes on distribution and migration of birds were published in 1888 under the title 'Bird Migration in the Mississippi Valley,' and the report on 'The English Sparrow in America' appeared in the following year. The latter report contained a full account of the sparrow and its introduction into the United States, its depredations on crops, and recommendations for destroying it, or at least preventing its increase. Special attention was called to the desirability of legislation permitting the destruction of the bird. It is interesting to note that at the time the bulletin was issued the English sparrow was practically protected by law in twenty-two States, although Ohio and Michigan had taken steps to exterminate it, while now most of the States have withdrawn protection, and Illi-

nois, Michigan, Ohio, and Utah have vainly attempted to destroy the pest under the bounty system.

"FUNCTIONS OF THE DIVISION FROM THE STAND-POINT OF ECONOMIC ORNITHOLOGY.

"From the stand-point of economic ornithology the Division may be said to have three functions: (1) to determine as accurately as possible the food of birds of economic importance; (2) to act as a court of appeal to investigate complaints concerning depredations of birds on crops; (3) to diffuse the results of its work and educate the public as to the value of birds. In studying birds' food dependence is placed chiefly on examination of stomachs to ascertain what has been actually eaten. Stomachs are collected in different localities at all seasons and in sufficient numbers to show clearly the character of the food. The stomach contents are examined microscopically and identified by comparison with reference collections of seeds and insects. This laboratory examination is supplemented by experiment and field work.

"INVESTIGATIONS REGARDING SUPPOSED INJURIOUS BIRDS.

"Species popularly considered injurious, such as hawks and owls, the crow, blackbirds, woodpeckers, and blue-jays, received attention first. A report on hawks and owls was undertaken by Dr. A. K. Fisher, one on the crow by Professor W. B. Barrows, assisted by Mr. E. A. Schwarz in the identification of insect material, while the investigations on the crow blackbird, woodpeckers, and blue-jay were made by Professor F. E. L. Beal.

"The destruction of birds of prey in Pennsylvania, following the passage of the 'scalp act' of 1885, had attracted wide-spread interest, and showed the necessity for correcting erroneous views concerning the value of hawks and owls. About two thousand seven hundred stomachs of these birds were collected, the contents carefully examined, and the re-

sults published in 1893 in a bulletin entitled 'Hawks and Owls of the United States,' illustrated by twenty-six colored plates. Of the seventy-five species and subspecies which occur in America north of Mexico, only six were found to be injurious, while several were shown to be beneficial. About the time the work was begun bounties on birds of prey were, or had recently been, offered by Colorado, Indiana, New Hampshire, Ohio, Pennsylvania, Virginia, and West Virginia. At present not only have all the important State bounties been withdrawn (the acts still in force are mainly local), but several States have adopted protective measures. New Hampshire and Ohio began with eagles, Rhode Island with fish-hawks, and New York and Minnesota with owls. Pennsylvania and Alabama now protect all except the six or seven really injurious species, while during the present year Utah has gone so far as to make it unlawful to kill any hawks or owls. Such changes show the gradual appreciation of the value of these really useful birds.

"In the case of the crow nearly one thousand stomachs were examined, and the charges of pulling up sprouting corn, of injuring corn in the milk, of destroying fruit, and of destroying eggs of poultry and wild birds were all sustained. But it was found that corn in the milk formed only three per cent. of the total food, and most of the corn destroyed was waste grain; that the destruction of fruit and eggs was trivial, while, on the other hand, many noxious insects and mice were eaten. The verdict was therefore rendered in favor of the crow, since, on the whole, the bird seemed to do more good than harm.

"Similar studies of crow blackbirds (based on about two thousand three hundred stomachs) and woodpeckers (including nearly seven hundred stomachs), published in 1895, showed that these birds were decidedly beneficial. Only one of the seven species of woodpeckers examined—the yellow-bellied—exhibited any questionable traits,—namely, a fond-

ness for the sap and inner bark of trees. Of the forty or fifty birds, exclusive of hawks and owls, thus far investigated, the English sparrow is the only one which has been condemned.

"INVESTIGATIONS REGARDING BENEFICIAL BIRDS.

"A number of species usually considered beneficial have also received attention. The Baltimore oriole, the meadow-lark, red-winged blackbird, rose-breasted grosbeak, cedar-bird, robin, bluebird, swallows, and several flycatchers have been studied by Professor Beal, and the shrikes, cat-bird, mocking-bird, brown thrasher, and house wren by Dr. Sylvester D. Judd. One of the interesting facts brought out in studying the cat-bird was the discovery that some birds prefer wild to cultivated fruits, so that the latter may be protected by planting certain berry-bearing shrubs and trees, especially in regions where wild fruit is naturally scarce. The king-bird, frequently condemned as a destroyer of honey-bees, was shown to eat very few bees, and these mostly drones. On the other hand, it kills many of the destructive robber flies, and a large proportion of its food is made up of destructive insects, so that it must be regarded as decidedly beneficial. Recent investigations show less favorable results in the case of some other flycatchers, and indicate that the prevailing idea that all insectivorous birds are necessarily beneficial may require decided modification, and that there are birds which habitually feed on beneficial insects to such an extent as to lower their value to the farmer, if not to place them among the enemies of his crops.

"RESULTS OF FOURTEEN YEARS' WORK.

"As a result of fourteen years' work, the Biological Survey has brought together a collection of about thirty-two thousand bird stomachs, of which some fourteen thousand have been examined. It has investigated about one hundred species (nearly half hawks and owls) and prepared the results for

publication in the form of bulletins or special papers. The publications on birds already issued include seven special bulletins, fifteen papers in the Annual Reports for 1886–1893, inclusive, and eight papers in the Yearbooks for 1894–1898. Some of these papers, such as 'Seed-planting by Birds,' 'Hawks and Owls from the Stand-point of the Farmer,' 'Birds that injure Grain,' and 'Birds as Weed Destroyers,' deal with general topics of special interest. The investigations on some thirty grain- and insect-eating birds were summarized in 1897 for a bulletin entitled 'Common Birds in their Relation to Agriculture,' and the work of the Division has also formed the basis of two important summaries, one by Miss Florence A. Merriam, entitled 'How Birds affect the Farm and Garden,' the other by Professor Beal, on 'Economic Relations of Birds and their Food.'

"The educational work of the Biological Survey has not been confined to laboratory studies or publications. The Division has prepared exhibits to illustrate the food habits of birds and modern methods of investigation for the expositions at Cincinnati in 1888, Chicago in 1893, Atlanta in 1895, and Nashville in 1897. It endorsed the proposition to establish a 'Bird-day' in the schools in 1894, and issued a circular on the subject two years later. Ever since its organization it has acted as a bureau of information on all subjects relating to birds or their distribution and habits. In short, it has spared no effort to advance the cause of economic ornithology in every possible way."

Such a record as this is certainly one in which any company of workers may well take pride. And when we realize how few the workers have been and how great has been the territory they have covered, we can but feel that remarkable results have been accomplished.

As to the future progress of economic ornithology it is becoming more and more evident to careful students of the subject that much of the best work hereafter must be inten-

sive rather than extensive. In the preliminary stages of our knowledge the miscellaneous collection of bird stomachs from all parts of the country at all seasons of the year is a necessary and useful step. The results thus obtained in regard to many species are of great value, but in the case of others, notably those of doubtful utility to man,—as, *e.g.*, the fly-catchers mentioned above by Dr. Palmer,—they must be supplemented by careful studies on the intensive plan. An excellent example of this is Dr. S. D. Judd's notable study of the food preferences of the cat-bird,[1] and other studies of the same sort are being made by Dr. Judd and other members of the Biological Survey on a farm near Washington controlled by the Survey.[2]

It was long ago pointed out by Forbes that many of the most important problems in economic ornithology rested at bottom upon the science of entomology. And in the difficult and perplexing problems that arise in the case of many species a fuller development of entomological knowledge is greatly needed. One of the most important of these topics is that of the relation of parasitic insects to each other and to their hosts.

The discussion in this chapter has been purposely restricted to the development of our knowledge of the more general economic relations of birds. For a history of the various special phases of the subject—game, eggs, feathers, guano, introduction of foreign birds—the reader is referred to Dr. Palmer's article in the Yearbook of the Department of Agriculture for 1899.

---

[1] American Naturalist, vol. xxxi. pp. 392–397.

[2] See "Birds of a Maryland Farm," Bulletin No. 17, Division of Biological Survey.

Photographed from life by Dr. R. W. Shufeldt.

CEDAR-BIRDS.

CHAPTER III.

THE VEGETABLE FOOD OF BIRDS.

A COMPREHENSIVE survey of the feeding habits of birds leads to the conclusion that the common terms vegetivorous and insectivorous have but a relative significance. They imply predominance in a given diet rather than an exclusive restriction to it. We cannot indicate a single finch, grouse, or pigeon—the most exclusive of the vegetarians—and say that it never eats insects, while on the other hand, after being assured that swallows and flycatchers—the most persistent of the insect hunters—sometimes eat berries, we cannot feel justified in maintaining upon purely negative evidence that any of the so-called insectivorous birds never eats vegetable food.

The vegetation eaten by birds may conveniently be considered under three heads,—namely, fruits, foliage, and roots. Under the first would be included all seeds and seed-bearing products of plants; they may be subdivided into seeds and achenes, nuts, and fleshy fruits. Under the second head would be comprised leaves, buds, and blossoms; while the third would include roots and root products.

The largest proportion of the seeds eaten by birds are produced by herbs, most of which are useless, while many of them are noxious weeds. The quantity of pestiferous seeds thus annually destroyed is enormous, and man is deeply indebted to the birds that destroy them. The great group of many-flowered plants—the order *Compositæ*—supplies food for a multitude of small finches. Early in the season the downy heads of the dandelion call sparrows and goldfinches to lawns and road-sides. A little later horse-weeds and thistles furnish similar food to the same hungry company. The ragweed, which springs up unbidden everywhere, is perhaps

the best bird provider in this family; in grain-fields, along road-sides, and in worn-out pastures this plant affords the birds a feast unsurpassed either in amount or duration. During the latter part of their stay the summer sparrows largely depend upon it; while in the winter bob-whites, gold-finches, redpolls, English sparrows, snow-flakes, and horned larks make festival among its miniature branches. Even the red-headed and red-bellied woodpeckers as well as the flicker have been known to partake of these ragweed seeds.

The buckwheat family—the order *Polygonaceæ*—also furnishes a liberal supply of food to many birds. The list of birds that devour these triangular seeds is a long one. Knot-weed, sheep-sorrel, dock, bindweed, and many more—each contributes to the birds that frequent its station. Juncos, chipping-sparrows, and redpolls come to the door-yard to glean among the knotweed; cow-birds, redwings, mourning-doves, bob-whites, and flickers look for the seeds of dock and bindweed in fields and meadows; mallards, teals, and other river ducks dabble for the seeds of water-smartweed and other aquatic or semi-aquatic varieties, making a full meal of them whenever they are able to do so.

The seeds of the pigweeds, hemp, mullein, and a host of other weeds belonging to less numerous families are also freely drawn upon for the support of bird life.

The wild grasses of the order *Graminæ* also supply their share. Among them the pigeon and other grasses of the genus *Setaria* are perhaps the most important in bird economy, as they invade cultivated ground everywhere and are fed upon very generally by sparrows and many other birds. In swamps and along the borders of ponds and streams, especially in the Southern and Western States, wild rice grows abundantly, and during the autumnal migration it is often the predominating element in the diet of such marsh-loving birds as bobolinks, blackbirds, rails, and ducks, all of which become very fat upon it.

Cultivated grains are consumed in varying quantities by a large number of birds, though comparatively few commit appreciable depredations, the grain eaten being generally gleaned after harvest. All varieties of small grain, such as wheat, rye, oats, and related kinds, are taken without apparent discrimination. The birds that habitually feed upon them are those already named as eaters of the larger seeds,—crows, jays, blackbirds, pigeons, prairie-chickens, and other members of the grouse family, sparrows, meadow-larks, horned larks, brown thrashers, towhees, and others. The crows, blue-jays, blackbirds, and English sparrows do considerable harm at times, though it is probable that the insects destroyed at other times by all except the English sparrow go far to compensate the loss. Pigeons and grouse are not sufficiently abundant to do much damage. In the West wild ducks and geese visit the grain-fields and sometimes cause considerable injury by taking the sprouting seed from the newly sown fields. During the fall migration the southern rice-fields attract many birds. Foremost among these are the bobolinks, or rice-birds as they are called in the South, and blackbirds, both of which at this time are content to live by rice alone. They assemble in countless flocks and commit serious depredations against the rice-planters. Ducks and other water-birds also resort to the rice plantations for a share of the plunder, but what these get is generally compensated for in the feathers and flesh that the owners obtain.

Indian corn, or maize, on account of its larger kernels is precluded from the food list of most of the sparrows, but otherwise it has the same depredators as the smaller grains. Among the casual devourers of maize are the woodpeckers and nuthatches, which seem to prefer it to all other cereals.

Cultivated grasses and clover seeds are frequently taken by sparrows. Sunflower seeds are sought by the more arboreal finches, like the purple finch, goldfinch, and the cross-bills. In the garden we find that lettuce, turnip, and similar seeds

are enjoyed by goldfinches, and that English sparrows and Baltimore orioles occasionally fall into the evil habit of eating green peas. Except in rare instances, however, these garden invasions are insignificant.

Among the trees that contribute seeds to the birds, the different species of elms deserve notice, the more especially as their seeds mature earlier than those of most other plants. The seeds of the widely diffused white elm ripen in the latitude of central New England about the first of June, and at once become a lure to the arboreal seed-eaters,—cross-bills, goldfinches, and purple finches,—which when the seeds fall follow them to join the host of "ground sparrows," song, vesper, and others, that ordinarily live on the seeds of weeds and do not feel at ease away from the cover of low vegetation.

The birches are also important elements in bird food, because their tiny winged seeds are quite persistent, many of them clinging to the catkins throughout the winter. They offer an unfailing supply so long as they remain upon the trees, and are liberally patronized by the winter finches, redpolls, siskins, and cross-bills. The small gray birch is levied upon in autumn by chipping and field sparrows, and in winter it becomes an especial favorite with juncos, tree-sparrows, and redpolls. Seeds of the yellow birch are sought by redpolls, siskins, and cross-bills, the last two more particularly as they prefer the woods, where this species is usually found, to more open pastures. The seeds of the other birches are also eaten to some extent, but they do not appear to be held in such high regard by birds as the two kinds that have been mentioned.

Maple seeds are more or less important in bird economy according to circumstances. As a rule, the sparrows and finches do not care for them so much as for smaller seeds that are more easily swallowed. The winter grosbeaks, pine and evening, however, find them quite to their taste, and give them almost exclusive attention so long as the supply holds out. It sometimes happens that a severe drouth in August

dries the stems of maple seeds before they have become woody, so that they are tough enough to withstand the blasts of autumn, and thus remain upon the trees indefinitely. Under these conditions the grosbeaks find life easy and never quit the neighborhood of trees thus laden until the last seed is plucked. If the ground is not covered with snow, they frequently obtain maple seeds after these are fallen.

Among the other deciduous trees bearing dry fruits eaten by birds are the poplars, sycamores, and ash-trees. None of them are in general favor, however, the larger finches and grosbeaks being their only patrons.

The cone-bearing trees cater to a rather select company of birds. This is particularly true of the white pine, the vaned seeds of which are so deeply hidden between the scales of its great cones that they cannot be extracted by ordinary bird tools. There are a few specialists, however, endowed with an appetite for such seeds and an adequate apparatus for obtaining them. These are the cross-bills, whose falcate mandibles are admirably adapted for grasping the vane of a pine seed and thus withdrawing it from its hiding-place. The siskin is another lover of pine seeds, and it is able to supply its wants by having a bill which for a finch is very long and acute. Although most of the white-pine seeds fall in September, enough remain in place to keep the birds supplied until early winter. Besides these specialists, several other birds occasionally eat pine seeds. Any of the seed eaters

WHITE-WINGED CROSS-BILL.

finding these strewn upon the ground seem ready to accept them, as are also the woodpeckers and the brown creepers, when fortune favors them with stray kernels in famine time.

Hemlock cones are so much smaller than those of the white pine that the seeds are more accessible, and consequently have a somewhat larger following. The siskins and the cross-bills are very fond of them, and wherever they find a fruitful growth they are likely to remain till the store is spent,—usually about midwinter. After the snow has come, covering the weeds, goldfinches also resort to the hemlocks. Even the chickadees, nuthatches, and woodpeckers seem to find it agreeable to sandwich these seeds in with their fare of frozen insects.

The spruces have larger and more refractory cones than the hemlock, and rank about with the white pine in bird economy. The other coniferous trees are of varying importance in this connection, but an account of them would not differ materially from that for those already mentioned.

Comparatively few of the vegetivorous birds are capable of devouring nuts. Crows and blue-jays, by holding them between their toes and their perch, are able with their strong bills to remove the shells from any of the thin-shelled nuts, and during the mast season feed largely upon them. The wild doves, pigeons, grouse, turkeys, and many of the ducks eat them entire, leaving the task of shelling to their muscular gizzards. To all these birds nuts are a standard article of diet. To the nuthatches and woodpeckers they are among the contingencies, as a rule, though some of the western woodpeckers seem to depend upon them considerably for winter food. The smaller nuts, or nutlets, approaching the borderland of the seed-like achenes, such as those of the hornbeams and basswood, are eaten to some extent by the grosbeaks and woodpeckers.

There are a number of dry fruits intermediate between nuts and soft fruits which are of some consequence to birds

on account of their persistence. The various sorts of sumach berries fall in this class. These berries remain throughout the winter as they grew, and during the season of want add materially to the food supply of northern birds. Ruffed grouse, crows, jays, woodpeckers, nuthatches, and chickadees frequently partake of them when the ground is covered with snow. Brown thrashers, cat-birds, mocking-birds, bluebirds, robins, and even kingbirds eat them at times, though probably never to any considerable extent. It is interesting to

CEDAR-BERRIES.

note in passing that the berries of the poison-ivy and poison-sumach are eaten as freely as those of any other species of equal abundance.

The small hard berries of the red cedar and juniper contribute to the livelihood of practically the same company. They are especially sought by cedar-birds and are evidently enjoyed by purple finches, pine grosbeaks, and myrtle warblers; the latter bird, however, depends in cold weather more upon bayberries than anything else. In fact, it gets its name from one of the vernacular names of the shrub that

bears them,—wax-myrtle. Bayberries are also eaten by other winter birds and late migrants, much the same as sumach and cedar-berries are.

These dry fruits must be reckoned as necessities rather than luxuries in bird economy: except the bayberries, they are seldom eaten when more palatable fruit is to be had.

THE MYRTLE WARBLER.

Pulpy fruits, on the contrary, are evidently enjoyed by birds, for they form the main diet of many normally insectivorous birds just when insects are most abundant. Of the various plants, large and small, bearing pulpy fruits, those of the rose family (*Rosaceæ*) hold first place from our present

point of view. Among the many kinds of fruit produced by this family the cherries are most important, as they are eaten by all birds accustomed to taking fruit of any sort and are to be had in unlimited quantity during more than two months in the year.

The wild red cherry, which is the first to ripen, is least esteemed, though cedar-birds appear to find it quite satisfactory. Birds in general, however, eat these far more sparingly than they do the later varieties. Choke-cherries and black cherries form an appreciable percentage of the food of cedar-birds, thrushes, orioles, jays, crows, and grouse from the time the first choke-cherries begin to grow brown in midsummer until the rains and frosts of autumn have despoiled the black-cherry trees of the last of their shining loads. Grackles, fly-catchers, sparrows, woodpeckers, and pigeons assist to a limited extent, but cedar-birds and robins are the most persistent devourers, with the flicker a close follower. The large numbers of cherries consumed as well as the variety of birds involved doubtless depend somewhat on the fact that cherry-trees grow in all sorts of places. The shy grouse and the woodland thrushes, cat-birds, and thrashers are able to get plenty of them without being exposed to the dangers of open ground; while the familiar robins and cedar-birds, which prefer cleared land, find all they want by road-sides and pasture fences.

Wild strawberries, raspberries, and blackberries are all dear to the avian palate. The first are not so largely eaten as the other two, for the reason that many birds which undoubtedly relish them do not like to hunt for them in the grass. Raspberries and blackberries are available to a larger number. Cat-birds, brown thrashers, and sparrows are at home in a brier patch and enjoy the fruits thereof. The ruffed grouse makes a regular practice of living in blackberry thickets while the fruit is on the vines and during that time feeds upon little else. The running blackberries, or dewberries, near the coast

are frequently eaten by the larger shore-birds, such as the curlews and plovers.

The shad-bush or service-berry, another member of the rose family, is of some value to birds, more especially as its fruit matures early. It is visited by the same group of birds that flock to the cherry-trees later in the season, but the quantities taken are not large. The fact that birds do not gorge themselves with the berries seems to be not through any fault of the berries, but rather because they ripen at a time when a more concentrated food is needed for the prosecution of vernal activities. When the nesting season is over and the year's labor done, comes the time for relaxation, moulting, and a general rejuvenescence. Then fruit is in order: each bird according to its nature seeks its favorite; crows and jays prefer mast and go to the nut-trees; sparrows loiter among the weed-thickened stubble; robins, cedar-birds, and a host with similar tastes gather at the cherry-trees.

WILD BLACK CHERRIES.

Although early fruits are more or less neglected, late varieties of ever so mean quality receive more attention. The berries of the mountain-ash, the last of the wild species of the rose family to be mentioned here, are among the latest maturing of the wild fruits. They are unpalatable to

our taste, but the rear guard of the southern-bound migrants eat them with apparent relish. Cedar-birds, robins, and other thrushes are especially fond of them.

The shrubs belonging to the honeysuckle family (*Caprifoliaceæ*) produce a number of soft fruits which are consumed by birds. Those of the Viburnums—sheep-berry, withe-rod, cranberry-tree, etc.—are all patronized by grouse, woodpeckers, and the thrushes and their allies, though by no means with the zest shown for cherries and other more favored fruits. The elder-berries, on the other hand, have a more pronounced following. The common elder-berry in particular attracts birds in such numbers and variety that it ranks among the leading wild fruits in this connection. The red-berried elder is not so highly regarded, though it is visited by wood-peckers and a few other birds.

Among the late-maturing berries are those of the dogwoods, belonging to the order *Cornaceæ*. There are several sorts of these which birds seem to hold in about equal esteem. They are taken in moderation by nearly or quite all the birds mentioned above as feeding upon fruits of this nature. The one berry in this order of which the birds are particularly fond is the sour-gum. Thrushes, woodpeckers, crows, jays, and grouse are found assembled for this and persistently abiding by it until the supply is gone.

Among the heaths (*Ericaceæ*) the most prominent fruits on the avian bill of fare are the blueberries and huckleberries. The abundance and edible qualities of these berries suffice to account for their large consumption by all the fruit eaters. Birds find the seclusion of the bushes not less agreeable than the good food, just at a time when both are needed. It is not strange that so many of them desert orchard and village trees for the blueberry pastures when the trials of rearing the young are over.

The black alder, of the holly family (*Ilicineæ*), is another late-maturing berry eaten by woodpeckers and the thrushes

and their allies. After the leaves have fallen the bright red color of these berries renders them very conspicuous. To us they have an abominable taste, but evidently the birds do not dislike them. In the wooded swamps where they grow one may often find robins up to the verge of winter, long after these birds have disappeared from the fields, subsisting almost wholly on these berries. Other members of the Ilex family, such as the holly and Cassenna, are also eaten.

Among the miscellaneous small fruits devoured by birds must be mentioned the grapes and the berries of the Vir-

A SPRAY OF BARBERRIES.

ginia creeper, which are taken by woodpeckers and many other birds. The mulberry has many devotees, among them the cuckoos. Pokeweed, in spite of its poisonous properties, supplies berries for a multitude of birds. It is a notable fact that wherever a wood-lot is cleared, pokeweed—if it grows anywhere in the neighborhood—is sure to spring up in abundance from seeds dropped by birds at their roosts. Partridge-berries, which remain unchanged through the winter, are relished by grouse and pigeons in both spring and fall.

The persistent fruit of the common barberry, which along the New England coast is thoroughly established, ministers largely to the support of the robins, flickers, bob-whites, and ruffed grouse that winter here. Persimmons, hackberries, spice-berries, cranberries, crowberries, sarsaparilla, greenbrier, Indian turnip, and many other wild fruits are eaten by birds to a greater or less extent, but none of them compare in importance with those that have been mentioned.

THE CULTIVATED FRUITS.

Of the cultivated fruits, cherries are subject to pilferings by cedar-birds and robins to an irritating extent. Cat-birds and woodland thrushes are less troublesome, on account of their retiring habits. Strawberries, raspberries, and blackberries are similarly affected. Currants and gooseberries are on the food list of the robin and the English sparrow at least. Apples are tasted by pine and evening grosbeaks, woodpeckers, blue-jays, English sparrows, and ruffed grouse, but the fruit thus molested is usually of poor quality, growing in out-of-the-way places. The grosbeaks eat both seeds and pulp of the apple during their winter peregrinations. In autumn the ruffed grouse frequents the neighborhood of scrub apple-trees in the alder runs as well as in neglected fields, and for a month or so subsists largely upon apple pulp.

Pears, plums, peaches, and oranges are occasionally tapped by English sparrows and woodpeckers, but none of these has yet acquired the habit of molesting such fruits to any considerable extent.

On the whole, the harm done by birds to cultivated fruits is of comparatively little consequence, except in some of the special fruit-growing regions. Probably it rarely begins to offset the good done by the birds through the destruction of insects.

BUDS AND BLOSSOMS.

A few birds make a practice of eating the buds of trees and shrubs. These are mostly winter birds which otherwise could scarcely find subsistence in the North after snow falls. While snow lasts the ruffed grouse lives almost wholly upon buds, preferring those of poplar, apple, and maple trees, but occasionally sampling the tips of birch, hazel, and other twigs. Pine and evening grosbeaks are also fond of buds, apparently without much regard as to kind, for they eat the buds of a large number of trees, both evergreen and deciduous. In early spring the swelling buds of oaks, maples, and elms are relished by the rose-breasted grosbeak, purple finch, English sparrow, and the cross-bills.

In the garden and orchard the buds of grape-vines, currant-bushes, peach, plum, cherry, apple, and pear trees are sometimes eaten by English sparrows, purple finches, and pine grosbeaks, but it is rare that any injury from this cause is noticed. The ruffed grouse, however, is capable of inflicting real damage by a too close pruning of buds, and cases are known where apple orchards located near woods have been rendered useless by them.

The blossoms of trees are of considerable indirect interest to a number of birds because they attract so many insects. Orioles and warblers are always associated with apple blossoms in the mind of the naturalist, because he invariably finds them associated in nature. They may sometimes eat a petal or a few stamens: they certainly destroy a multitude of insects. The cedar-bird, however, has a liking for petals, and devours them greedily, and so does the purple finch. Probably other birds will be found to take parts of flowers. But the eating of petals and stamens can hardly be deemed injurious until it becomes much more common than at present.

The only native birds that are given to eating leaves are the few wild species that are most nearly related to our domestic

fowls. The wild turkey, all of the grouse, the geese, and many of the ducks feed freely upon them. None of these birds seem to have much preference, but take such leaves as are found convenient. The ducks, for instance, are usually limited to aquatic plants. Eel-grass is eaten by many of them, notably the scaups, the red-head, and the canvas-back. Geese are more terrestrial, and consequently they enjoy a more extensive bill of fare. The more strictly vegetivorous grouse plucks right and left, as may be inferred from the following list of leaves taken by us from the crops of ruffed grouse: crowfoot, chickweed, clover (both white and red), strawberry, barren strawberry, everlasting, dandelion, golden-rod, sheep-laurel, sheep-sorrel, apple, and willow. Sheep-laurel, so poisonous to lambs, is eaten with impunity, though it is thought to render the flesh of the bird poisonous to man.

Roots are mostly exempt from consumption by birds. The crow occasionally uncovers newly planted potatoes and feeds on them. Both Irish and sweet potatoes are relished by cranes, which are said also to devour the roots of pond-lilies. The roots and bulbs of aquatic plants are eaten by geese and vegetivorous ducks whenever they are to be had. Only the larger birds are powerful enough to get at roots or to eat them after they are exposed. The great majority are content to let them fulfil their mission, and await results above ground.

SAP.

The sap of maples, birches, mountain-ash, and a few other trees is enjoyed by several of the wood-pecking birds. Chickadees may be seen, at the right seasons, tapping the smooth twigs of maples and attentively sipping the forth-coming drops. Some of the woodpeckers have the same habit. The most notorious among them are the yellow-bellied woodpeckers, or sapsuckers, which are inveterate tipplers of the sap of black and canoe birches and mountain-ash. They also eat the tender inner bark of these and other trees.

CHAPTER IV.

THE ANIMAL FOOD OF BIRDS.

In the later pages of this volume the fact will become apparent that a very large proportion of the food of birds consists of insects,—the little creatures that fill the air, the water, and the earth with life. Adult insects in general have a body divided into three parts, called the head, the thorax, and the abdomen, with three pairs of legs, one pair of antennæ, and usually two pairs of wings. They are grouped together in certain natural orders, of which, from our present point of view, the following are the most important.

The order Orthoptera includes the crickets, grasshoppers, cockroaches, locusts, and walking-sticks. These insects have four wings, the front pair being thick and leathery, and the hind pair thin and membranous.

There are few groups of injurious insects that enter so largely into the composition of the food of birds as do the locusts, or short-horned grasshoppers, of the family *Acridiidæ*. The enormous destructive power of these insects is well known, but our indebtedness to birds in checking their oscillations is less generally recognized. No more convincing proof of the latter, however, could be required than Professor Samuel Aughey's records of the food of birds in Nebraska during outbreaks of the Rocky Mountain locust,—records which show that birds of all sizes and kinds turned their attention to reducing the ranks of the invaders. Similar results may be seen in many portions of the United States whenever the local non-migratory species of locusts become unusually abundant. The life-history of these insects is simple: the eggs are deposited late in summer or early in autumn a little below the surface of the soil; the following spring they hatch

Photographed from life by Dr. R. W. Shufeldt.

THE YELLOW-BILLED CUCKOO.

into young, which resemble in a general way the adults. These young 'hoppers feed upon grass, clover, and similar plants, increasing gradually in size and occasionally shedding their skins. In the course of about two months they acquire wings and become full grown. The Rocky Mountain locusts develop normally on the high, dry table-lands of the Rockies and occasionally migrate in vast numbers to the fertile fields of the Mississippi Valley. The red-legged locust is the most abundant of the widely distributed species of this family. These insects form a large part of the food of nestling birds as well as of the adults.

STAGES OF THE ROCKY MOUNTAIN LOCUST.
(*After Riley.*)

The family *Locustidæ*, which includes the long-horned grasshoppers and katydids, is at once distinguished from the *Acridiidæ* by the very long antennæ. These insects are also of much less economic importance, but some species occasionally become seriously injurious. They are often preyed upon by birds, both in the egg and mature states, the latter frequently being fed to nestlings, and with some species of birds they form a comparatively important element of food.

The crickets, belonging to the family *Gryllidæ*, are abundant everywhere in fields and meadows, and probably do considerably more damage than they are usually accused of. In the Northern States the common black species usually winters over in the condition of the egg, although a few manage to come through in a partially grown state. Their eggs are deposited in the ground by means of the long pointed ovipositor of the female. The climbing or tree crickets of the genus Œcanthus are perhaps the most injurious members of the family. They deposit their eggs in the canes of the rasp-

berries and in the twigs of various fruit- and shade-trees, making longitudinal slits that cause the death of the cane or twig. The adult tree-crickets feed to a considerable extent upon aphides, and so are by no means an unmixed evil. They are occasionally eaten by birds.

The most destructive species of the Hemiptera, or half-winged insects, is the chinch-bug, a pest that often causes losses amounting to millions of dollars in a single State and a single season. The adult is a blackish insect, slightly less than one-fifth of an inch long, with the legs dark yellow and their tips black. The young do not differ from the adult in general form. When first hatched they are pale yellow, but they soon become red; this continues to be the prevailing color until the pupa or last nymph stage is reached; the insect is then grayish or brownish black. The eggs are small and amber-colored. These pests attack corn and small grains in enormous numbers, sucking out the sap and thus weakening or destroying the plants.

TARNISHED PLANT-BUG.
Magnified.

The chinch-bug is the type of a large group of the true bugs called the Heteroptera, another typical example of which is the tarnished plant-bug, illustrated herewith. There are many different families in this suborder, a large proportion of which are protected from being eaten by birds by their disagreeable odor, which is doubtless the accompaniment of an equally disagreeable taste.

The other suborder of the Hemiptera—called the Homoptera—includes several important families of noxious insects, the members of which, fortunately, enter largely into the food of birds. The most notable of these families are those of the leaf-hoppers and the plant-lice.

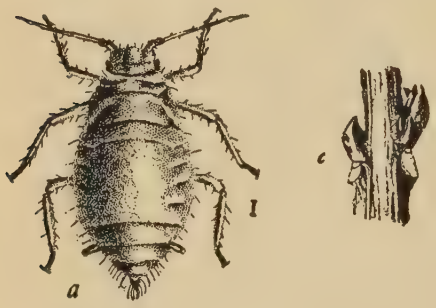
The leaf-hoppers of the family *Jassidæ* are very often found in the stomachs of birds. These insects are small

creatures with elongate-oval bodies and hind legs fitted for jumping. An idea of their appearance may be obtained from the accompanying picture, which represents the well-known rose leaf-hopper. The adult of this species is about one-tenth of an inch long, with a yellowish-white body and white semi-transparent wing-covers. It injures the rose-leaves by sucking out the cell contents, giving the upper surface a white-spotted appearance. One or more members of this family live upon a large proportion of the flowering plants, both wild and cultivated, and often do serious damage.

ROSE LEAF-HOPPER.
Magnified.

None of the true bugs are so constantly and generally injurious as the plant-lice, or aphides, which form the family *Aphididæ*. The common "green fly" of house plants is an example of this group, and nearly every cultivated crop is subject to the attack of one or more species. The normal life-history of these little creatures may be briefly outlined in this way: In the spring there hatches from an egg deposited the autumn previous a little plant-louse that sucks the sap of its food-plant for a number of days—sometimes for a fortnight—before it becomes fully grown. During this period of growth it moults, or sheds its skin, a number of times, to provide for its rapidly increasing size. This plant-louse, which developed from the egg, is often called the "stem-mother:" she is always wingless. Soon after reaching maturity she commences to give birth to living young, continuing the process for several days. These young resemble the stem-mother in general appearance, being, of course, much smaller. Each soon begins sucking sap on her own account, and in the course of ten days or a fortnight becomes mature and commences to bring other living aphides into the world; the latter soon mature and give birth to a

third generation. All of these early broods are what are called parthenogenetic females, giving birth to living young without the presence of any males. Many of these plant-lice are provided with wings, but the majority are wingless. This process of reproduction is continued throughout the warm season, but on the approach of cold weather a true sexual generation is produced, the males of which may be either winged or wingless, while the females are always wingless. By union of these two forms the true winter eggs are produced: the eggs are generally deposited upon the branches of trees or other plants; they pass through the winter and in spring hatch into stem-mothers which renew the cycle of existence.



AN APHID, MAGNIFIED, AND ITS EGGS ABOUT BUDS.

Many of the smaller birds, such as the warblers, nuthatches, kinglets, and chickadees, appear to feed largely upon aphides and their eggs. These insects are only rarely found in the stomachs of larger birds, like the robin, cat-bird, and the various thrushes. A large part of the winter food of the chickadee consists of the eggs of aphides.

The moths and butterflies form the order Lepidoptera, or scaly-winged insects. Under the microscope their wings are shown to be covered with minute scales which overlap one another. The adults are very different from the larvæ, and in consequence these insects are said to undergo complete transformations. The three later stages of the common caterpillar which infests cabbages—the cabbage-worm—are represented in the picture herewith. The female butterflies deposit their pale greenish-yellow eggs, singly or in clusters, on the leaves; the larvæ soon hatch and feed upon the sur-

THE CABBAGE BUTTERFLY.

a, larva; *b*, chrysalis; *c*, *d*, butterfly.

face of the cabbage, eating more and more as they develop. When fully grown each spins a slight silken loop on the cabbage-leaf or some near-by shelter, generally on the lower surface, and changes to a pupa or chrysalis. In a short time it emerges as a butterfly.

A large proportion of the caterpillars of the Lepidoptera are eagerly devoured by birds, forming an important element of the food of many species. Mention can be made here of only a few of the more important families.

There is a large family of small moths called *Tortricidæ*, the larvæ of which are commonly known as "leaf-rollers." The normal habit of these little caterpillars is to feed upon the surfaces of leaves which they roll into a protective covering; sometimes they live singly and sometimes a number live together in a common nest. Insects of this family attack the leaves of nearly all our fruit and ornamental trees, although, fortunately, they generally do little damage. Some species are not content with the foliage, but feed upon the fruit; the too well-known codling-moth, or apple-worm, is an example of this group. The larvæ, pupæ, and moths of the leaf-roller family are all eagerly devoured by birds, but these insects are greatly protected by their habits and colors, so that probably birds do

MINE OF APPLE LEAF-MINER.

not affect them so seriously as they do the insects of many other groups.

The leaf-miners differ from the leaf-rollers in that the larvæ live within the tissues of the leaf, as in the case of the apple leaf-miner illustrated on the opposite page.

The families of looping or measuring caterpillars—*Geometridæ* and its allies—are of special interest from an ornithological point of view because they contain many species which in their larval state so closely resemble small twigs that they easily escape the notice of birds. A few species, like the canker-worm, are of much economic importance on account of their injuries to the foliage of fruit and shade trees. Such species, as a rule, are less perfectly protected in their resemblance to twigs than others, and when abundant are freely eaten by birds. The moths of these families have slender bodies and comparatively large wings, although sometimes the females are wingless.

The great family of night-flying or owlet moths—called by entomologists *Noctuidæ*—includes a large number of the most injurious insects. The boll-worm of cotton, the army-worm, and the various cut-worms, all belong here. The cut-worms are rather thick, naked worms which hatch from eggs laid by medium-sized moths. Most of them feed upon grass or clover when young, becoming half grown before winter. They hibernate beneath some shelter and in spring come forth in search of food, attacking a variety of young plants by biting off the stems and feeding on the leaves. They become full grown during spring or early summer, pupate beneath the soil surface, and a fortnight or more later emerge as moths.

THE ARMY-WORM.
(*From New York Experiment Station.*)

Fortunately, cut-worms and their allies form a large proportion of the food of many birds. They are especially used by the old birds for feeding the nestlings.

The families of silk-spinning moths and their allies—formerly included under the Bombycidæ, but now subdivided into many groups—include a number of the most injurious insects affecting fruit and shade trees. The larvæ of this group are hairy caterpillars which feed upon leaves, and when full grown spin silken cocoons for protection in the pupa state. The tent caterpillar of the apple and wild cherry, the fall web-worm, the tussock-caterpillar, and many similar insects belong here. One of the most notably destructive members of the group is the gypsy moth, recently so prominent before the public in Massachusetts. The two sexes of the adult moth in this species differ greatly: the general color of the male is brownish and of the female whitish. The eggs are laid in bunches in a great variety of situations, and the resulting larvæ feed upon the foliage of nearly every kind of tree and shrub.

TENT CATERPILLAR'S NEST RAIDED BY BIRDS.

Comparatively few birds attack the hairy caterpillars of this group, but some—as the cuckoos and blue-jays—devour them eagerly. The European cuckoo is said to regurgitate the mass of skins thus swallowed; probably our species have a similar habit. The larger bombycid caterpillars—like those of the cecropia and polyphemus moths—are eaten by some of the hawks.

The highest group of the Lepidoptera includes the familiar butterflies. In their earlier stages they are caterpillars, many of which form a portion of the diet of birds.

Many of the larger butterfly larvæ seem to be protected from the attacks of birds by a disagreeable taste or smell. The caterpillars of the beautiful papilios have a peculiar pair of yellow or orange-colored Y-shaped organs concealed just back of the head. When the larva is irritated these are thrust out; they emit a very disagreeable odor and are supposed

A CRANE-FLY.

to be useful as a means of protection from birds and other animals.

The order of two-winged flies—Diptera—contains comparatively few families of injurious insects. The species most

destructive to cultivated crops appears to be the little Hessian fly (*Cecidomyia destructor*), often so serious an enemy to wheat. The adult is a small gnat-like creature whose eggs are deposited on the blades of growing wheat, the resulting larvæ absorbing the sap of the plant and dwarfing or destroying it. Closely related species attack the heads of clover and of wheat. There is no doubt that great numbers of these flies are devoured by swallows, swifts, and nighthawks during the aerial evolutions of these birds.

The long-legged crane-flies of the family *Tipulidæ* are often found in birds' stomachs. The adults of these insects appear in spring, often in great numbers, and deposit their eggs in grass-lands. A short time later the eggs hatch into small, blackish, footless grubs, that feed upon grass-roots and decaying vegetable matter. When full grown they are about an inch long and of a grayish-black color. They now change to pupæ, to emerge as adult flies a fortnight later. The larvæ sometimes do serious injury to meadows.

The Coleoptera, or sheath-winged insects, form the immense order which includes the beetles. The front wings are hardened into horny cases which cover and protect the membranous second pair, the mouth parts are formed for biting, and the transformations are complete. In the larval state the beetles are commonly called grubs. A typical example of a beetle is illustrated on the opposite page. Many beetles are destructive to vegetation, a few live on decaying organic matter, and some prey upon other insects.

The tiger-beetles form a distinct family (*Cicindelidæ*), the members of which devour many other insects, being predaceous in both the larval and adult states. These beetles are often brightly colored and marked with distinct spots. They are abundant in sandy situations and may be seen commonly along lanes and roads or by the sides of streams. Many of them are eaten by certain kinds of birds.

The ground-beetles of the family *Carabidæ* form an im-

portant element in the food of many birds, especially the thrushes and their allies. These beetles vary much in their habits: some of them—especially those belonging to the genus Harpalus and others related to it—feed largely upon vegetation of various kinds, while others—particularly those of the genus Calosoma and its allies—are strictly carnivorous, being excellent examples of predaceous beetles. The vegetivorous group enter most largely into the food of birds. Many of the carnivorous ones are so protected by offensive taste or odor that they are not eaten at all. Some of the larger ground-beetles are called "caterpillar hunters," because they prey upon cutworms, canker-worms, and various other caterpillars.

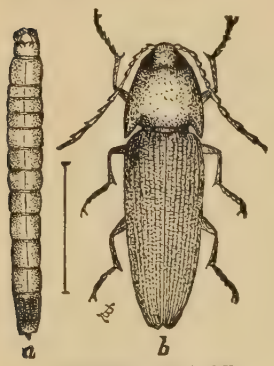
TIGER-BEETLE.
Magnified. (*From Insect Life.*)

The lady-beetles, or "lady-birds," of the family *Coccinellidæ*, are extremely useful as destroyers of plant-lice and other insects. Fortunately, they appear to be distasteful to birds, as they are very seldom eaten by them.

The hard, cylindrical, yellow worms frequently found in the soil of meadows and grain fields and commonly called "wire-worms" are the larvæ of the click or snapping beetles of the family *Elateridæ*. These larvæ feed upon the roots of plants and sometimes do serious damage to young corn and wheat. They are extremely difficult to combat by artificial means; hence we are glad to know that both the larvæ and adults are fed upon to a considerable extent by various birds.

In the great family of leaf-beetles—the *Chrysomelidæ*—which is said to include more than ten thousand described species, we find many insects which are destructive to cultivated crops. The most notorious American member of the

family is the Colorado potato-beetle, but there are many others, such as the corn-root worm, the various flea-beetles, the striped cucumber-beetle, and the asparagus-beetle, which are almost equally injurious. The larvæ of this group vary much in appearance and life-history: some live exposed on leaves, others are leaf-miners, and others live on roots and under ground. Most of the larvæ are protected in some way from the attacks of birds, which apparently devour many more of the adult beetles than of the larvæ.



CLICK-BEETLE AND LARVA.
(*After Bruner.*)

The common May-beetle, or "June-bug," belongs to a family—*Scarabæidæ*—which contains many other well-known depredators. This insect is developed from the white grub, or "grub-worm," so often found in pasture and meadow land. The rose-beetle, or "rose-bug," is one of the others: the adult is a hard, brown insect that feeds upon the foliage, flowers, or fruit of a great variety of plants. Its eggs are deposited in light sandy soil and the larvæ feed upon roots. When fully grown they change to pupæ and later emerge as adult beetles. Grubs like these are eagerly devoured by robins, blackbirds, crows, and others; these natural enemies aid greatly in checking the ravages of such pests.

A large number of injurious insects are found among the snout-beetles of the family *Curculionidæ* and certain related families grouped together in a suborder called Rhyncophora. The plum and apple curculios, the bean and pea weevils, the various grain weevils, the corn "bill-bug," the white-pine borer, and many other pests belong here. The larvæ of these insects are usually footless grubs and feed upon a variety of materials. The adult beetles have a habit when disturbed of dropping to the ground, drawing the legs against the body,

and remaining quiet for some time. Many of them resemble particles of rubbish of such various sorts as commonly occur at the soil surface. This means of escaping observation doubtless saves some of them from the attacks of birds, but nevertheless a considerable number are eaten by our feathered allies. The salient features in the life-history of the family may be gathered from that of the plum-curculio. The adult beetles deposit eggs in the young plums and the resulting grubs feed upon the pulp of the fruit. They become full grown in a few weeks, the plums fall to the ground, and the grubs enter it to pupate, emerging later as beetles.

The ants, bees, wasps, sawflies, and various four-winged parasites form the order Hymenoptera. The jaws of these insects are fitted for biting and the remaining mouth parts for sucking. The transformations are complete, and the adults, with few exceptions, have two pairs of membranous wings with few veins. This order includes some highly beneficial as well as some extremely injurious species.

Few families of insects enter more largely into the food of birds than that of the ants (*Formicidæ*). Being abundant in all sorts of situations, it is not strange that woodpeckers, cat-birds, and various other species of birds have learned to rely upon them for much of their food. Some people class ants among the beneficial insects, but, while they are doubtless useful in certain ways, it seems to us that there can be no question that birds which eat them should receive credit rather than blame for so doing. The ants are so abundant and multiply so rapidly that were there no check upon their increase they would be likely to become very troublesome, as indeed they now are in many localities.

Probably the most important group of parasitic insects is that comprising the ichneumon-flies of the families *Braconidæ* and *Ichneumonidæ* of modern entomologists. These little creatures vary greatly in life-habits, but a large proportion of them are primary parasites of injurious insects. The

adults are four-winged flies with slender bodies and long antennæ, and the larvæ are soft, fleshy grubs. In many species the females have long egg-depositors, by which they can reach caterpillars hidden in trunks of trees or stems of herbaceous plants. The eggs are usually deposited either on or in the body of the larva selected as the victim: they soon hatch into grubs that develop at the expense of the tissues of the host. Some of the ichneumon-fly larvæ are internal parasites, living beneath the caterpillar's skin, while others attach themselves externally. In either case the host insect is doomed: it may be killed long before it gets its full larval growth, or it may be allowed to complete that growth and spin a cocoon, but sooner or later the parasites—like the fox in the fable—will gnaw away its vitals. When the ichneumon larvæ become fully grown, they generally spin slight silken cocoons, within which they change to pupæ, to emerge later as adult flies.

SPHINX LARVA WITH COCOONS OF PARASITE; ADULT PARASITE AT RIGHT.
Natural size and magnified. (*After Riley.*)

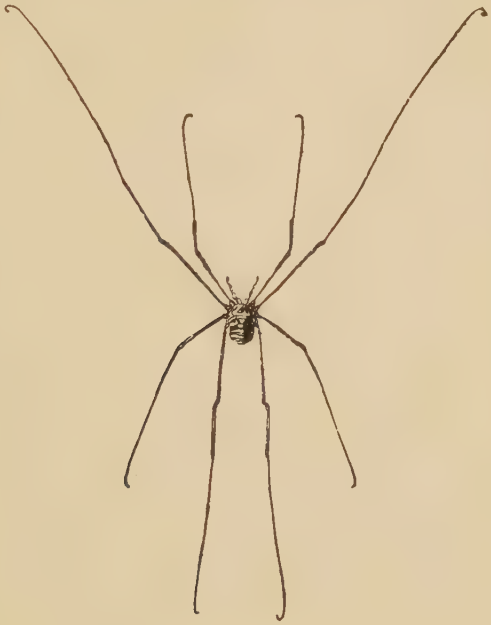
There is a group of ichneumon-flies, commonly called Microgasters, which spin their cocoons on the back and sides of the larvæ of butterflies and moths, giving the host a most singular appearance. A specimen of a common sphinx larva bearing these cocoons is represented above.

Ichneumon-flies are eaten to a considerable extent by many birds, especially the flycatchers. The fact that a bird may eat a certain number of insects of this sort without necessarily doing any injury to agriculture is indicated in the discussion of the relations of vegetivorous and carnivorous insects in Chapter VI.

Besides the insects proper there are many animals that are eaten by birds. The spiders are the most important of these.

Spiders have eight legs, with a body divided into two principal parts, and are predaceous creatures which feed largely upon insects. They are found in all sorts of places and during all seasons of the year. They enter very largely into the dietary of the smaller birds, being especially fed to the nestlings, and their surprising rate of reproduction seems to have been developed, in part at least, to meet this constant drain upon their numbers.

The harvest-spiders, harvest-men, daddy-long-legs, or grab-for-gray-bears, as they are variously known in different parts of



A HARVEST-SPIDER.

the United States, form a distinctive family,—*Phalangiidæ*,—distinguished by having the three divisions of the body—head, thorax, and abdomen—closely united, and four pairs of very long legs. A common species is pictured above. These

harvest-spiders are predaceous creatures, feeding especially on the aphides, or plant-lice, as well as upon dead insects. Most of them move about at dusk, rather than during the day. Notwithstanding the disagreeable odor given off by them when handled, they are occasionally found in birds' stomachs.

The common "thousand-legged worms" form a subclass of animals known to naturalists as Myriapoda,—the many-footed. They abound under logs and rubbish or amid the fallen leaves of the forest, where they are often picked up by robins or other thrushes. Some Myriapods, of which the common Iulus is an example, feed upon vegetable matter, and are occasionally destructive to strawberries by eating the pulp of the fruit. Others are predaceous; but very little is known precisely concerning the food habits of these; consequently their economic status is ill defined. From their general habits we are led to think that their value may easily be over-estimated and that we need not regret their occasional destruction by birds.

In addition to insects and their allies, birds feed upon many higher animals. Fishes are taken habitually by kingfishers, ospreys, the wading birds, and some of the owls. Frogs, lizards, and snakes are eagerly devoured by hawks, owls, and other raptorial birds, as well as by some of the waders and various other species. The mice, moles, shrews, gophers, ground-squirrels, and other small rodents also form a large part of the food of the birds of prey as well as of many other species, while the smaller birds themselves furnish considerable subsistence for their larger relatives.

Photographed from life by Dr. R. W. Shufeldt.

AMERICAN LONG-EARED OWL.

CHAPTER V.

THE AMOUNT OF FOOD CONSUMED BY BIRDS.

Birds as a class are the most active members of the animal kingdom. They have rapid circulation and respiration: are constantly on the alert during all seasons of the year; travel long distances in migrating or searching for food; rear large families, often two or more broods in a summer; and, in short, perform for their size a prodigious amount of work. Because of this, one would expect them to require a large amount of food to keep up the energy they are so constantly expending, and the studies that have so far been made show that such is emphatically the case.

Unfortunately, the problem of ascertaining just how much food wild birds need presents many difficulties in the way of its solution. So long as birds are at liberty, evidence must always be fragmentary and often uncertain. When they are kept in captivity, natural conditions are upset: the worry of confinement, the lack of exercise, and a changed diet are factors of more or less importance; we can scarcely say how much. With nestlings the matter is simpler, though much time and patience and common sense are necessary in order to obtain creditable results.

Thus, it is not to be wondered at that in the whole mass of ornithological literature—which latterly has increased to very respectable proportions—there is a striking paucity in this line. It is to be hoped that the gap will not be allowed to exist very much longer, as reliable data on the *amount* of food consumed is in economic importance second only to the *kind* consumed. Although information is scarce, yet there is enough to demonstrate that the quantity of food eaten by birds is relatively much greater than that consumed by any other class of vertebrates.

Sixteen canaries mentioned by Dr. Stanley[1] ate one hundred grains of food per day, about one-sixth of their own weight. "A gull kept and fed in a garden devoured in one day fourteen mice and two rats. Another was seen to swallow an entire rat, an operation, however, not accomplished without some difficulty, the bird making several efforts before it succeeded, and even then the tail remained visible for several minutes."[2]

In *The American Naturalist* for July, 1899, Dr. Thomas H. Montgomery, Jr., gave some valuable data concerning the food of owls, based on a study of food pellets regurgitated at roosts. In the winter of 1898–99 four long-eared owls took residence in an arbor-vitæ tree on Dr. Montgomery's grounds at West Chester, Pennsylvania, and from December 25 till February 22 were under his observation. Pellets were gathered weekly and analyzed. In the fifty-nine days the pellets from beneath this one tree yielded remains of two birds, one shrew (*Blarina*), one common mouse (*Mus*), and three hundred and forty-five field-mice (*Microtus*). Under a Norway spruce near by, where a short-eared owl roosted regularly and one of the long-eared occasionally, were found between February 26 and March 26, twenty-eight days, evidence of one crawfish, five birds, two shrews, one jumping mouse (*Zapus*), and one hundred and five field-mice. Pellets believed to have come from the same owls, found under trees within a radius of an eighth of a mile, contained remains of five birds (*Regulus*, *Junco*, *Certhia*), seven shrews, and one hundred and forty-eight mice. Taken altogether here was an equivalent of one owl for two hundred and forty-six days, to which are credited twelve small birds, ten shrews, and six hundred mice, or about two and one-third animals, mainly mice, per day.

For twenty-two consecutive days, December 25 to January 15, Dr. Montgomery counted four owls in the arbor-vitæ tree

[1] History of Birds, p. 225.

[2] Id., p. 143.

every day. The pellets taken from beneath the tree during that time showed parts of one finch, one shrew, and one hundred and ninety-nine mice. Dividing 201, the number slain, by 88, the number of days in which one owl would consume the same amount, we have 2.28,—what he would have eaten in one day. As it is probable that more or less pellets were dropped elsewhere, we may readily believe that the average daily consumption deduced from the whole number of pellets is within the lines of truth.

An adult crow that had been slightly wounded in the wing was once brought in and kept alive by us awhile for a food experiment. He was put into a small box, twelve by thirteen by twenty inches, and kept supplied with water, cracked corn, and oats. In addition, from twenty to sixty angle-worms were given him each day for five days. By that time he was fairly tame and ate freely while being watched. We secured a quantity of small fish (*Fundulus*), which were abundant in the brackish creeks, and offered him some on the fifth day. He ate thirty grammes of them that day in addition to grain and the usual supply of earthworms. On the sixth day his animal food comprised sixty-eight angle-worms, ten shrimps, and eighty-five grammes of fish. By this time his wing was nearly healed, he was feeding well and showed a relish for fish, and, as we could procure them in unlimited numbers, we decided that the conditions were right for the final test.

On the morning of the seventh day every eatable was removed from his cage, and a basin of water containing a number of the living fish put in. As fast as the fish were taken out others were supplied. For three days he ate nothing else. During that time he consumed fourteen and a half ounces (avoirdupois),—making his daily consumption 4.83 ounces, more than a quarter of his own weight. It would take over four hundred grasshoppers at maturity to weigh as much as did his daily ration of fish. As there is no reason to suppose that uncaged birds would eat less than this cap-

tive, a little multiplying will show that a crow devours an astonishing amount of food in a year.

A ruffed grouse killed in winter had in its crop twelve leaves of sheep-laurel and four hundred and thirty-five buds and bits of branches from apple and maple trees. Some of the twigs were half an inch long. That was the morning meal. It would have been duplicated at twilight. The crop from another bird of the same species contained over five hundred buds and twigs. From these examples it appears that the daily requirement of this grouse lies between eight hundred and one thousand buds. At other seasons of the year it is impossible from an examination of its crop contents to judge with any certainty how much a grouse eats, as then the birds eat at all times of day.

Professor Herrick,[1] in his study of the red-winged blackbird, noted that three nestlings received food forty times in four hours on one day, and forty-three times in three and a half hours on another day. Four young kingbirds[2] were fed ninety-one times in four hours. Two young red-eyed vireos[3] took grasshoppers, katydids, green larvæ, beetles, and bugs of many kinds, also a few berries, once in fifteen minutes during two days and once in nine minutes on the third day. Four young cat-birds[4] received food forty-six times in four hours, after the old birds had become reconciled to the presence of the observer. Five times in succession large dragon-flies (*Eschna heros*), just from their pupa-skins, were brought in. Beetles, moths, larvæ, and strawberries were among the items.

A brood of three young cedar-birds watched by us made an average gain during the first eleven days of 1.13 drams, avoirdupois, per bird per day. Excreta, voided on an average of three per hour, averaged to weigh one-sixth of a dram during the same period. Reckoning fifteen hours of activity

[1] The Home Life of Wild Birds, p. 21.
[2] Id., p. 27. [3] Id., p. 69. [4] Id., p. 78.

per day, the total amount of excreta passed by each bird is 7.5 drams. Adding the daily gain to the daily excretion gives 8.6 drams, the daily food during the eleven days. After the eleventh day more nutrition goes into feathers and less to flesh, so that the gain in weight is not so great as before; but the excreta continue to increase in proportion to the bird's development, and the parents are in constant attendance, so it is clear that there is at least no diminution in the food supply after the eleventh day. During the fifteen days that the young birds spent in the nest, they devoured not less than ten ounces apiece, —more than ten times their weight on the day of flight.

Photographed from life.

CEDAR-BIRD AT NEST.

Another cedar-bird taken after it had left the nest, and kept under surveillance but not confined, took a good-sized black or choke cherry every ten minutes. When given two, he invariably doubled the time between meals. This bird was captured at night. The next morning the character of its excrement indicated that there was little or no food matter in the digestive organs. The fast was broken by two black cherries; the stones were dropped forty-five minutes later. A blackberry was digested in half an hour. The cherries were given entire, and their large size evidently delayed their passage from the œsophagus into the proventriculus, for the bird stretched his neck as if in distress after they had been swallowed awhile.

Mr. Daniel E. Owen has recorded[1] some interesting observations on the food of a young hermit thrush recently from the nest. It ate regularly half its weight of raw beefsteak each day, and probably would have taken as much more had it been fed at sufficiently frequent intervals. Perhaps the most interesting point brought out was a method of determining the rapidity of digestion in young birds. Having noticed that the blueberries eaten dyed the excrement, it occurred to Mr. Owen that "this fact furnished a ready method of finding the length of time required by the thrush to digest blueberries. The test was made July 26. At 12.56 P.M. of that day, the bird voided white excrement and was fed at once with blueberries. At 2.28 P.M., one hour and thirty-two minutes later, it dropped blue excrement mingled with berry seeds. If this experiment was trustworthy, and I see no reason to doubt the accuracy of the method, the time required for a blueberry to traverse the digestive tract was, practically, one hour and a half."

A brood of young cedar-birds confined by Mr. Frank Bolles[2] and fed by the old birds were supplied with eight thousand four hundred cherries in twelve days.

Three robins about ten days old observed by us were fed in two hours one bird-cherry (*P. pennsylvanica*), one large cricket (*Gryllus*), one smooth caterpillar an inch and a half long, one moth (*Noctuid*), one harvest-man (*Phalangiidæ*), one tumble-bug (*Copris*), two earthworms (*Lumbricus*), two carabid beetles, twenty-nine grasshoppers (*Acridiidæ*), and eight small creatures thought to be spiders but which could not be made out with certainty. These forty-seven items were brought at thirty visits between 4.04 and 6.03 A.M. During the middle of the day the old birds came less often. Between 10 and 10.30 there were four visits, from 1.25 to 1.51

[1] The Auk, vol. xiv. pp. 1–8.

[2] Id., 1890, vol. vii. p. 290.

there were six, and from 2 to 3 there were six. Ten visits per hour was the average the day through.

Over three-fourths of the food brought consisted of adult grasshoppers, the great Carolina locust being often among them. Half of the time two were brought at a visit. Only a little calculation is necessary to show that each occupant of the nest consumed about eighty insects that day, of which at least sixty were grasshoppers. An average red-legged locust—the species most commonly brought—weighs five grains Troy; sixty of them would weigh three hundred grains, and adding the twenty-five per cent. consisting of worms, beetles, berries, etc., we have four hundred grains as the weight consumed by each nestling on that particular day. They were then about ten days old; their average weight was seven hundred and eleven grains. Thus it appears that they ate per diem more than half their own weight.

Mr. Charles W. Nash[1] gives this experience with the food of a young robin: "In May, 1889, I noticed a pair of robins digging out cutworms in my garden, which was infested with them, and saw they were carrying them to their nest in a tree close by. On the 21st of that month I found one of the young on the ground, it having fallen out of the nest, and in order to see how much insect food it required daily I took it to my house and raised it by hand. Up to the 6th of June it had eaten from fifty to seventy cutworms and earthworms every day. On the 9th of June I weighed the bird; its weight was exactly three ounces; and then I tried how much it would eat, it being now quite able to feed itself. With the assistance of my children I gathered a large number of cutworms and gave them to the robin after weighing them. In the course of that day it ate just five and one-half ounces of cutworms. These grubs averaged thirty to the ounce, so the young robin ate one hundred and sixty-five cutworms in one

[1] Birds of Ontario, p. 22.

day. Had it been at liberty it would probably have eaten some insects of other species and fewer cutworms, but this shows about what each young robin requires for its maintenance when growing; the adult birds require much less, of course. The average number of young raised by a robin is four, and there are usually two broods in the season. A very simple calculation will give a good idea of the number of insects destroyed while the young are in the nest."

Five young goldfinches which we watched were from the beginning fed by their parents almost exclusively upon seeds of the bull-thistle (*Cnicus pumilus*, Torr.). At the age of one week rather more than the product of one thistle-head was divided among them at each meal. They were fed every half-hour on an average, the old birds feeding independently. Not less than thirty thistle-heads were thus consumed in a day by these young birds when they were scarcely more than half-grown.

A family of four song-sparrows seven days old received seventeen grasshopper nymphs, from five-eighths to three-fourths of an inch long, and two spiders between 1.55 and 3.02 P.M.—sixty-seven minutes. As they were out of the nest the next day, it may be accepted that they are hearty eaters. Eight days is a short time for the accomplishment of so great a change.

A brown thrasher at ten visits made in one hundred and twenty-six minutes delivered to one of her young just out of the nest one spider, one earthworm, one hairy caterpillar an inch and a half long, two Carolina locusts, seven red-legged locusts, and three other insects which were not identified.

A bobolink brought to two fledglings between 5.13 and 5.33 one afternoon,—twenty minutes,—nine grasshoppers. The next morning between 9.18 and 10.05,—forty-seven minutes,—ten grasshoppers were brought. About that time one of the young birds escaped. To the remaining one he fed eleven grasshoppers in two hours. Of the thirty 'hoppers

all but two were green, some belonging to the family *Acridiidæ* and others to the family *Locustidæ*.

Dr. Sylvester D. Judd,[1] from an observation on the food of three young house-wrens about three-fourths grown, reports that "The mother made one hundred and ten visits to her little ones in four hours and thirty-seven minutes, and fed them one hundred and eleven spiders and insects. Among these were identified one white grub, one soldier-bug, three millers (*Noctuidæ*), nine spiders, nine grasshoppers, fifteen May-flies, and thirty-four caterpillars. On the following day similar observations were made from 9.35 A.M. till 12.40 P.M., and in the three hours and five minutes the young were fed sixty-seven times. Spiders were identified in four instances, grasshoppers in five, May-flies in seventeen, and caterpillars in twenty."

Four chipping-sparrows about five days old devoured thirty-seven grasshoppers, several of which were adults, but most of them half-grown nymphs, between 4.37 and 6.06 P.M., —eighty-nine minutes. The next morning between 9.56 and 10.45,—forty-nine minutes,—they ate eighteen grasshoppers and two full-grown measuring worms (*Cingilia*). A single young chippy lately out of the nest was seen to take food —grasshoppers chiefly—thirty times in sixty-five minutes.

A brood of three chipping-sparrows watched by us one entire day received food one hundred and eighty-seven times. It was not possible to determine the exact nature of all that was brought, but it appeared to be wholly insectivorous, cutworms and other caterpillars being often observed.[2]

These observations are certainly sufficient to establish the fact that birds as a class consume an enormous amount of food.

---

[1] Yearbook, U. S. Dept. of Agr., 1900, p. 413.

[2] Weed, Feeding Habits of the Chipping-Sparrow, N. H. C. Ag. Exp. St., Bull. 55.

CHAPTER VI.

BIRDS AS REGULATORS OF OUTBREAKS OF INJURIOUS ANIMALS.

It is well known that, as a rule, the most damage to cultivated crops is done by the species of insects and other noxious animals which fluctuate greatly in numbers. In this chapter we have to determine whether in the presence of an extraordinary abundance of a given edible animal birds vary their food ratios by taking unusual numbers of the species in question. If they do, it is evident that they assist in reducing the pest to its normal limit; if they do not, they neglect an opportunity for usefulness.

Four examples may serve to illustrate the tendencies of birds under such conditions. The first relates to the canker-worm, the second to the Rocky Mountain locust, the third to the army-worm, and the fourth to the European vole, or field-mouse.

A few years ago a large apple-orchard in central Illinois was severely attacked by canker-worms. As a result of their depredations a considerable part of the orchard had the appearance at a little distance of having been ruined by fire. To determine whether the birds of the region were exerting themselves to check this outbreak, Professor S. A. Forbes visited the orchard for two successive seasons, shooting each time a number of birds of the various species present. The stomach contents of these were afterward carefully examined: from the published record[1] of the results we have made the following summary.

---

[1] Bulletin of the Illinois State Laboratory of Natural History, vol. i., No. 6.

THE CAT-BIRD.

Nine robins had eaten only animal food, of which canker-worms formed twenty, cutworms twenty-eight, and vine-chafers fourteen per cent., making a total of sixty-two per

APPLE-LEAVES ATTACKED BY CANKER-WORMS.

cent. for these three groups of insects. Eleven per cent. of the remainder consisted of click-beetles (*Elateridæ*). Fourteen cat-birds were examined: they had eaten fifteen per cent. of canker-worms, ten per cent. of cutworms and other caterpillars, fourteen per cent. of ants, and thirty-three per cent. of vine-chafers. Four brown thrushes had eaten canker-worms, vine-chafers, June-beetles, click-beetles, ground-beetles, and other insects. Combining these food elements of twenty-seven members of the thrush family, Professor Forbes found that "none of them had eaten any vegetation whatever; that ninety-six per cent. of their food consisted of insects (myriapods and earthworms making up the remaining four per cent.); that sixteen per cent. was canker-worms, and only four per cent. predaceous beetles." The vine-chafer made just twenty-five per cent. of the entire food.

The most important element in the food of five bluebirds was the vine-chafer (thirty-six per cent.), while canker-worms formed twelve per cent. Two black-capped chickadees had

eaten only canker-worms and beetles, the former making sixty-one per cent. of the food and the latter belonging principally to a wood-boring beetle of the genus Psenocerus. Nearly half of the food of several house-wrens consisted of canker-worms.

THE BLUEBIRD.

Passing now to the warblers (*Mniotiltidæ*), we come to many species feeding largely on canker-worms. Four-fifths of the food of a single Tennessee warbler consisted of these insects. Two-thirds of that of five summer yellow-birds was canker-worms, and the same was true of two chestnut-sided warblers and also of four black-poll warblers. A single black-throated green warbler had eaten seventy per cent. of canker-worms, and two Maryland yellow-throats had eaten forty per cent. of these and forty per cent. of other caterpillars. Consequently canker-worms composed nearly or quite two-thirds of the food of these fifteen warblers. Seventy-nine per cent. of the food of three warbling vireos consisted of caterpillars, more than half of them being canker-worms.

Out of a flock of about thirty cherry-birds, or cedar wax-wings, seven birds were shot. With the exception of a few Aphodii (small beetles) "eaten by three of the birds in

numbers too insignificant to figure in the ratios, the entire food of all these birds consisted of canker-worms, which therefore stand at an average of one hundred per cent. The number in each stomach determined by actual count ranged from seventy to one hundred and one, and was usually nearly one hundred. Assuming that these constituted a whole day's food, the thirty birds were destroying three thousand worms a day, or ninety thousand for the month during which the caterpillar is exposed."

A specimen each of the cliff-swallow, American goldfinch, and yellow-winged sparrow had eaten no canker-worms. About one-third of the food of eight chipping-sparrows consisted of caterpillars, half of them being canker-worms. Three field-sparrows had eaten largely of canker-worms and various beetles, forty-three per cent. of the food of fourteen black-throated buntings consisted of canker-worms, and a very few of these worms had been eaten by two rose-breasted grosbeaks; they also formed fifty-nine per cent. of the food of eighteen indigo-birds.

No canker-worms were found in the stomachs of a single cow-bird and two red-winged blackbirds. Three Baltimore orioles, however, had eaten forty per cent. of these worms and fifty per cent. of vine-chafers. Two orchard-orioles made even a better showing. "More than three-fourths of the food of these consisted of canker-worms, and other caterpillars made an additional twenty per cent." Three bronzed grackles had eaten no caterpillars.

Passing now to the family of flycatchers we find that more than one-fourth of the food of three kingbirds consisted of canker-worms and fully one-half of vine-chafers. The food of three wood-pewees consisted entirely of flying insects. Two specimens of Traill's flycatcher had eaten twenty-five per cent. of canker-worms, and a single yellow-bellied flycatcher had eaten an equal percentage of vine-chafers but no canker-worms. A single black-billed cuckoo had eaten of

canker-worms seventy-five per cent., other caterpillars twenty per cent., and vine-chafers five per cent. Four red-headed woodpeckers had eaten fifteen per cent. of canker-worms, while a single golden-winged woodpecker had eaten only ants. No canker-worms were found in one mourning-dove and two quails.

Summarizing the above results into one general statement, it is found that one hundred and forty-one specimens belonging to thirty-six species were studied. "Twenty-six of these species had been eating canker-worms, which were found in the stomachs of eighty-five specimens,—that is to say, seventy-two per cent. of the species and sixty per cent. of the specimens had eaten the worms. Taking the entire assemblage of one hundred and forty-one birds as one group, we find that thirty-five per cent. of their food consisted of canker-worms."

A comparison was made, in the case of the robin, cat-bird, black-throated bunting, and indigo-bird, of the food in this orchard and that of the species during May under ordinary circumstances. These results showed that there was a general diminution of vegetable and miscellaneous food in the orchard specimens to compensate for the increase of caterpillars.

"Three facts," says Professor Forbes, "stand out very clearly as the result of these investigations:

"(1) Birds of the most varied character and habits, migrant and resident, of all sizes from the tiny wren to the blue-jay, birds of the forest, garden, and meadow, those of arboreal and those of terrestrial habits, were certainly either attracted or detained here by the bountiful supply of insect food and were feeding freely upon the species most abundant. That thirty-five per cent. of the food of the birds congregated here should have consisted of a single species of insect is a fact so extraordinary that its meaning cannot be mistaken. Whatever power the birds of this vicinity possessed as checks

upon destructive irruptions of insect life was being largely exerted here to restore the broken balance of organic nature. And while looking for their influence over one insect outbreak we stumbled upon at least two others, less marked, perhaps incipient, but evident enough to express themselves clearly in the changed food ratios of the birds.

"(2) The comparisons made show plainly that the reflex effect of this concentration on two or three unusually numerous insects was so widely distributed over the ordinary elements of their food that no especial chance was given for the rise of new fluctuations among the species commonly eaten. That is to say, the abnormal pressure put upon the canker-worm and the vine-chafer was compensated by a general diminution of the ratios of all the other elements, and not by a neglect of one or two alone. If the latter had been the case, the criticism might easily have been made that the birds in helping to reduce one oscillation were setting others on foot.

"(3) The fact that, with the exception of the indigo-bird, the species whose records in the orchard were compared with those made elsewhere had eaten in the former situation as many caterpillars other than canker-worms as usual, simply adding their canker-worm ratios to those of other caterpillars, goes to show that these insects are favorites with a majority of birds."

One of the most notable series of studies of the relation of birds to outbreaks of injurious insects was that carried on for thirteen years by Professor Samuel Aughey, of the University of Nebraska, concerning the extent to which birds feed upon the Rocky Mountain locust or grasshopper during the periodic outbreaks of that insect. Fortunately, the results of these studies have been preserved by the United States Entomological Commission.[1] Between 1865 and 1877 Pro-

[1] First Report, Appendix II.

fessor Aughey made a careful investigation of this subject, both by out-door observations of living birds and by in-door examinations of stomach contents. His tabulated results show conclusively that birds of all kinds were doing their best to reduce the numbers of the locusts. A brief summary of the principal facts will indicate the truth of this.

Beginning with the thrushes and their allies, we find that six robins had eaten two hundred and sixty-five locusts, three wood-thrushes had taken sixty-eight locusts, one hermit-thrush contained nineteen locusts, two olive-backed thrushes were responsible for the death of fifty-five 'hoppers, while two Wilson's thrushes had destroyed seventy-three more. Five cat-birds had eaten one hundred and fifty-two of these insects.

Sixty-seven locusts were taken from the stomachs of three bluebirds and twenty-nine from one little ruby-crowned kinglet, while four tufted titmice yielded two hundred and fifty of the pests and nine long-tailed chickadees contained four hundred and eighty-one of them. Four slender-billed nuthatches—the western representative of the white-breasted nuthatch—had eaten ninety-three locusts. Even the little warblers ate many of the pests, naturally choosing the younger specimens. Seven golden warblers had taken seventy-seven locusts and one hundred and seventy-six other insects. Five black-throated green warblers contained one hundred and sixteen 'hoppers and one hundred and four other insects. Four black-poll warblers had eaten one hundred and twenty-three locusts, varying their diet with forty-seven insects of other kinds. Eight prairie-warblers devoured one hundred and sixteen of the locusts and a greater number of other insects; while the golden-crowned thrush had fed upon both the 'hoppers and their eggs. Many warblers were seen feeding their nestlings with young locusts.

While the warblers paid most attention to the immature grasshoppers, the swallows fed chiefly upon the adult winged

insects, probably catching them in the air. Seven barn-swallows had eaten one hundred and thirty-nine, eight eaves-swallows three hundred and twenty-six, five bank-swallows one hundred and four, and ten purple martins two hundred and sixty-five locusts.

The vireos and shrikes were found to eat many of the pests, while some of the grosbeaks and finches ate the eggs as well as the 'hoppers. Three bobolinks had devoured an average of fourteen locusts each, while nine meadow-larks had taken two hundred and thirteen of the pests besides some of their eggs. Fifty-one locusts were taken from the stomach of a single yellow-headed blackbird, while the Baltimore oriole, Brewer's blackbird, and the purple grackle were noted as feeding almost exclusively upon the pests when the latter were abundant.

Even the raven, the crow, the magpie, and the blue-jay followed the prevailing fashion in the feathered world, eating large numbers of the locusts, although no doubt they did not wholly neglect the occupants of any of the nests of the smaller birds with which they came in contact. The flycatchers and pewees proved to be doing good service, while the stomachs of the whippoorwill and nighthawk were crowded with 'hoppers, three hundred and forty-eight being taken from seven specimens of the latter species.

It seems almost incredible that the tiny ruby-throated humming-bird should also have followed the fashion, yet Professor Aughey assures us that a specimen caught by a cat "had four small locusts in its stomach." After this we are prepared to learn that the stately kingfisher varies his scaly diet with an occasional 'hopper. Nor is it surprising that ten specimens of the highly insectivorous yellow-billed cuckoo had eaten four hundred and sixteen locusts as well as one hundred and fifty-two other insects.

The woodpeckers evidently varied their usual diet to an extraordinary degree on account of the presence of the grass-

hoppers. Six hairy woodpeckers had taken one hundred and fifty-seven locusts and one hundred and ninety-three other insects; four downy woodpeckers had eaten one hundred and sixty-five locusts and ninety other insects; five yellow-bellied woodpeckers contained one hundred and thirty 'hoppers and ninety-three specimens of other species; six red-headed woodpeckers had devoured one hundred and forty-nine locusts and two hundred other insects; while eight flickers contained two hundred and fifty-two of the 'hoppers together with one hundred and forty-nine insects of other species.

The extent to which birds of prey fed upon the locusts would surprise the many people who look upon hawks and owls only as enemies of the poultry-yard, deserving extermination. One barn-owl had eaten thirty-nine locusts, twenty-two other insects, and a mouse. Eight screech-owls contained two hundred and nineteen 'hoppers and many other insects, while nine burrowing owls had devoured three hundred and eighteen locusts. The hawks patterned after the owls; six marsh-hawks ate two hundred and forty-nine locusts, while two Swainson's buzzards had devoured one hundred and twenty-nine of the pests.

Even the pigeons and the gallinaceous birds which usually feed so largely upon grains and seeds added a considerable proportion of locusts to their diet. Professor Aughey writes that in locust years the wild turkey makes the pest its principal food. Four sage-cocks had eaten one hundred and ninety grasshoppers, while the sharp-tailed grouse, prairie-hen, and quail ate enormous numbers of them.

Passing now to the shore birds, the records of the golden plover, the American snipe, the various sand-pipers, godwits, tattlers, and curlews all tell the same story of locust destruction. Even the great blue-heron, American bittern, and sand-hill crane devoured the pests, while the rails and American coot added their efforts to subdue them. The snow-goose, the Canada goose, and the various ducks—including the mal-

lard, dusky duck, pintail, and blue-winged teal—contained quantities of 'hoppers. Two out of five white pelicans examined had varied their diet of crayfish and frogs by picking up locusts, one containing forty-one and the other sixty-seven specimens.

The gulls—including the black-backed, herring, ring-billed, and Franklin's rosy gull—had eaten many grasshoppers, as had also the least and the black tern.

It certainly would be difficult to obtain more striking evidence than this concerning the utility of birds in checking outbreaks of injurious insects. The fact that birds of all sorts and sizes, from the giant pelican to the tiny humming-bird, —birds of the prairie, the forest, the air, the shore, the sea, and the inland lake,—fed so largely upon the locusts proves beyond doubt that these feathered allies were using to the fullest extent a tremendous force to check the ranks of the invaders.

A few years ago the army-worm appeared in great numbers in Pennsylvania, causing much damage to field crops. The State zoologist, Professor B. H. Warren, made a careful series of investigations to determine the extent to which birds fed upon the pests. The results showed that a large proportion of the common birds devoured them eagerly. Crows, blackbirds, robins, cat-birds, thrushes, meadow-larks, and bluebirds were found to get a large part of their food from the hosts of the army-worms. Kill-deers, sand-pipers, and sparrows also fed freely upon them, while the screech-owl and the sparrow-hawk devoured great numbers of the pests.

Insects, however, are not the only animals against whose undue increase the agriculturist needs protection. In many parts of Europe there have been for centuries periodic outbreaks of field-mice that have caused enormous injury. The species oftenest concerned appears to be the short-tailed field-mouse (*Arvicola agrestis*), related to the common meadow-mice of the United States. There is abundant evidence that

at the times of such uprisings the birds of prey flock to the infested fields in great numbers. More than three centuries ago this fact was noticed, as is shown by the following paragraph from Stow's "Chronicle:"

"About Hallontide last past (1581), in the marshes of Danesey Hundred, in the county of Essex, there suddenly appeared an infinite number of mice, which overwhelming the whole earth in the said marshes did shear and gnawe the grass by the roots, spoyling and tainting the same with their venomous teeth in such sort that the cattell which grazed thereon were smitten with a murrain; which vermine by policy of man could not be destroyed, till at last it came to pass that there flocked together such a number of owls as all the shire was able to yield, whereby the marsh holders were shortly delivered from the vexation of said mice. The like of this was also in Kent."

Another "sore plague of strange mice" occurred in Essex in 1648. In 1754 a correspondent of the *Gentleman's Magazine* wrote from Market Downham, England: "Once in about six or seven years Helgay, about one thousand acres, is infested with an incredible number of field-mice, which like locusts devour the corn of every kind. Invariably there follows a prodigious flight of Norway owls, and they tarry until the mice are evidently destroyed by them."

Similar testimony exists concerning the more recent outbreaks. That of 1875–6—one of unusual severity, in which one-third of the pastures of the affected district were destroyed—was attributed partly to a series of mild winters and partly to the destruction of predacous birds and mammals. A recent English writer, Dr. W. B. Wall, says that "the chief enemies of the voles are the short-eared owl and the kestrel hawk, which will do more to reduce their ranks than all the traps of the agriculturist and the microbes of the scientist combined. The kestrel hawk is known to all, duly appreciated by a few, but still destroyed by too many. The

short-eared owl is one of our most valuable winter visitors, arriving about October and leaving usually in March. It frequents open moors, alights and secretes itself on the ground in preference to trees, and feeds by day as well as in the evening. In this winter of 1887–8 the moors were crowded with these birds, it being no uncommon occurrence to start two or more at the same time from the long grass; the explanation of their numbers no doubt being that the preceding dry summer had been most favorable to the increase of the animal life of the moors, which supplied ample food and inducements for the birds to congregate."

Mr. W. H. Hudson, in his fascinating book, "The Naturalist in La Plata," gives a graphic account of the suppression of an outbreak of mice on the pampas of South America. These little creatures had increased to an enormous extent, and animals of many kinds lived upon them. "In the autumn of the year countless numbers of storks (*Ciconia maguari*) and of short-eared owls made their appearance. They also came to assist at the general feast." The mice were soon reduced in numbers to a point far below their normal limit. A similar abundance of birds is noticed, Mr. Hudson says, whenever other animals—grasshoppers, crickets, or frogs—become excessively numerous on the pampas. He explains the concentration of these birds—usually seldom seen—upon the spot where food abounds by the statement that when not breeding they are constantly travelling in search of food, flying at great heights and covering a large territory in their wanderings. "When the favorite food of any one of these species is plentiful in any particular region, all the individuals that discover it remain and attract to them all of their kind passing overhead. This happened in the pampas with the stork, the short-eared owl, the hooded gull, and the dominican or black-backed gull,—the leading species among the feathered nomads; a few first appear like harbingers; these are presently joined by new-comers in considerable

numbers, and before long they are in myriads. Inconceivable numbers of birds are doubtless in these regions continually passing over us unseen."

In the presence of an unusual abundance of food the rate of increase of some birds becomes greater. It has been noticed that owls multiply rapidly when outbreaks of mice occur.

Testimony of this kind could be multiplied indefinitely: it unquestionably is sufficient to demonstrate that when an outbreak of mice or similar pests occurs the hawks and owls find an abundant food supply, of which they readily avail themselves, and in so doing check to a great extent the damage that might be done.

The evidence furnished by these examples suffices to show that birds do exert a decided influence in checking unusual outbreaks of injurious animals. They have been well likened to a great standing army which may be concentrated at short notice upon any locality where an outbreak occurs.

CHIPPING-SPARROW AT NEST.

CHAPTER VII.

THE RELATIONS OF BIRDS TO PREDACEOUS AND PARASITIC INSECTS.

The attempt is frequently made to belittle the usefulness of birds by the argument that they do as much harm by feeding upon predaceous and parasitic insects as they do good by devouring the injurious ones. For example, B. D. Walsh, the first State Entomologist of Illinois, claimed that a bird must eat at least thirty injurious insects for every beneficial one in order to be of economic value; and since then similar arguments have frequently been used. During the last few years students of bird food have commonly placed the results of their studies under these headings: "Beneficial," "Injurious," "Neutral;" including in the former all parasitic and predaceous insects. Before proceeding to a general discussion of the principles which underlie this whole subject, the absurdity of this assumption may easily be shown. Suppose an ichneumon parasite is found in the stomach of a robin or other bird: it may belong to any one of the following categories:

(1) The primary parasite of an injurious insect.

(2) The secondary parasite of an injurious insect.

(3) The primary parasite of an insect feeding on a noxious plant.

(4) The secondary parasite of an insect feeding on a noxious plant.

(5) The primary parasite of an insect feeding on a wild plant of no economic value.

(6) The secondary parasite of an insect feeding on a wild plant of no economic value.

(7) The primary parasite of a predaceous insect.

(8) The primary parasite of a spider or spider's egg.

This list might easily be extended still farther, and the assumption that the parasite belongs to the first of these categories is unwarranted by the facts and does violence to the probabilities of the case.

A correct idea of the economic *rôle* of the feathered tribes may be obtained only by a broader view of nature's methods, —a view in which we must ever keep before the mind's eye the fact that all the parts of the organic world, from monad to man, are linked together in a thousand ways, the net result being that unstable equilibrium commonly called "the balance of nature."

The fact that in eating insect parasites birds do not necessarily cause an economic loss was first pointed out by Professor S. A. Forbes in an admirable essay entitled "On some Interactions of Organisms." As we find it impossible to improve and difficult to condense the argument there printed, we quote the following extended extract.

"Evidently a species cannot long maintain itself in numbers greater than can find sufficient food year after year. If it is a phytophagous insect, for example, it will soon dwindle if it seriously lessens the numbers of the plants upon which it feeds, either directly by eating them up, or indirectly by so weakening them that they labor under a marked disadvantage in the struggle with other plants for foothold, light, air, and food. The interest of the insect is therefore identical with the interest of the plant it feeds upon. Whatever injuriously affects the latter, equally injures the former; and whatever favors the latter, equally favors the former. This must therefore be regarded as the extreme normal limit of the members of a phytophagous species, a limit such that its depredations shall do no especial harm to the plants upon which it depends for food, but shall remove only the excess of foliage or fruit, or else superfluous individuals which must either perish otherwise if not eaten or, surviving, must injure their species

by overcrowding. If the plant-feeder multiply beyond the above limit, evidently the diminution of the food supply will soon react to diminish its own numbers, a counter reaction will then take place in favor of the plant, and so on through an oscillation of indefinite continuance.

"On the other hand, the reduction of the phytophagous insect below the normal number will evidently injure the food plant by preventing a reduction of its excess of growth or numbers, and will also set up an oscillation like the preceding except that the steps will be taken in reverse order.

"I next point out the fact that precisely the same reasoning applies to predaceous and parasitic insects. Their interests also are identical with the interests of the species they parasitize or prey upon. A diminution of their food reacts to diminish their own numbers. They are thus vitally interested in confining their depredations to the excess of individuals produced or to redundant or otherwise unessential structures. It is only by a sort of unlucky accident that a destructive species really injures the species preyed upon.

"The discussion thus far has affected only such organisms as are confined to a single species. It remains to see how it applies to such as have several sources of support open to them,—such, for instance, as feed indifferently upon several plants or upon a variety of animals or both. Let us take, first, the case of a predaceous beetle feeding upon a variety of other insects,—either indifferently upon whatever species is most numerous or most accessible, or preferably upon certain species, resorting to others only in case of an insufficiency of its favorite food.

"It is at once evident that, taking its food-insects as a unit, the same reasoning applies as if it were restricted to a single species for food: that is, it is interested in the maintenance of these food-species at the highest number consistent with the general conditions of the environment, interested to confine its own depredations to that surplus of its food which

would otherwise perish if not eaten, interested, therefore, in establishing a rate of reproduction for itself which will not unduly lessen its food supply. Its interest in the numbers of each species of the group it eats will evidently be the same as its interest in the group as a whole, since the group as a whole can be kept at the highest number possible only by keeping each species at the highest number possible."

Professor Forbes goes on to show that when the rate of reproduction of a parasite is relatively too great it causes fluctuations in numbers which are injurious both to the parasite and its host, and concludes that in a state of nature "the annihilation of all the established enemies of a species would, as a rule, have no effect to increase its final average numbers."

Such being the case where man has not interfered with nature, we have next to inquire to what extent these principles hold good, under the conditions of modern agriculture, for those insects which feed upon cultivated crops. Evidently a chief element of disturbance of the natural order here lies in the enormously increased food supply, an increase so great and so subject to multiplication by man that it is a rare event for an insect to reach its limit. If a crop in a given locality is destroyed by insects, seed from another region is usually planted the following season, so that, while under natural conditions the insect would have been starved out, it is instead given an increased opportunity to develop. In consequence of this, the law that no animal can multiply beyond the limits of its food supply becomes practically inoperative.

But while this is true of the plant-feeding species, it is not true of the parasite that preys upon it. The latter is still under the operation of the primal food law: when it has reduced the numbers of its host to a point where it must cease to multiply because there are no caterpillars in which to deposit its eggs, man does not step in and furnish a supply of caterpillars to keep up the activities of the parasite. Con-

sequently there is a great and sudden decrease of the numbers of the parasite.

In other words, while the law that no species can multiply beyond the limits of its food supply is rendered inoperative in the case of the host caterpillar, it continues to act in the case of the parasite, because man does not artificially increase the food supply of the latter. Man's interposition evidently has the effect of extending and intensifying the oscillations which would occur under natural conditions.

We must next determine the probable effect produced when a bird eats some of these parasites. It need hardly be said that the species of insects which live exposed are very much more likely to be eaten by birds when they are unusually abundant than when not numerous. When a hymenopterous parasite is found in a bird's stomach, the chances are greatly in favor of the assumption that the species to which it belongs is at the time more numerous than usual. The destruction of a portion of the parasites may not only involve no loss from an economic point of view, but may actually be a benefit, in that it will extend the period of effective operation of the parasite, and put off the time when it will cut off its own food supply by its too rapid increase. The probabilities do not justify the assumption that a bird usually does harm rather than good in eating a parasite of an injurious phytophagous insect.

Nothing has been said in regard to those parasites upon parasites which are called the secondary or hyper-parasites of noxious insects. Our knowledge of the precise biological relations of these is limited. On general principles it is probable that when a bird eats one of these it is at least as likely to be doing man a benefit as an injury.[1]

---

[1] For an account of the relations between hymenopterous parasites and their hosts, see Fiske, "The Parasites of the Tent Caterpillar," New Hampshire College Agricultural Exp. Station, Technical Bulletin, No. 6.

CHAPTER VIII.

THE THRUSHES AND THEIR ALLIES.

THE BLUEBIRD.

THERE is, perhaps, no feathered songster which has so endeared itself to the people of the northern United States as the bluebird. Clad in modest but beautiful colors, endowed with a voice of plaintive melody, and familiarly associating with man, it is one of the most delightful harbingers of spring.

THE BLUEBIRD.
(*After Biological Survey.*)

Its insect-eating habits are well known, for the bird may often be seen flitting from its perch in chase of some passing moth or grasshopper. The food of one hundred and eight Illinois specimens, taken in every month of the year except November and January, was studied by Professor S. A. Forbes. In February cutworms and ichneumon-flies formed the most important elements of the food, twenty-four per cent. of the

former and twenty-two per cent. of the latter having been eaten. The larvæ of the two-lined soldier-beetle, a predaceous species, had been eaten to the extent of eight per cent. and young grasshoppers to the extent of nine per cent. Ground-beetles formed five per cent. of the food, soldier-bugs seven per cent., spiders and crickets each four per cent. The ratios of parasitic and predaceous species were very high, these making thirty-nine per cent. of total food for the month.

In March thirty-eight per cent. of cutworms and related caterpillars, part of them being army-worms, and one per cent. of crickets and grasshoppers were eaten. In April large numbers of small dung-beetles were present in the stomachs. Eight per cent. of ground-beetles, nine per cent. of spiders, and twenty-one per cent. of caterpillars were also present. The number of spiders eaten in May was unusual, these forming twenty-one per cent. of the food. Moths, caterpillars, June-beetles, and grasshoppers had been eaten freely this month, forming fifty-five per cent. of the stomach contents. In June winged ants and various spiders had been eaten, as well as measuring worms and ground-beetles. A few birds had eaten a small number of raspberries and gooseberries.

The most remarkable elements of the food in July consisted of grasshoppers and crickets (twenty-seven per cent.) and June-beetles (twelve per cent.). Caterpillars, ground-beetles, and spiders composed the more important parts of the remainder. The chief business of the month of August was the pursuit of locusts, crickets, grasshoppers, moths, and caterpillars. The three first named amounted to more than half of the food for the month, and the moths and caterpillars to more than one-fourth. The only fruits present were a few wild cherries and elder-berries.

In September the common red-legged grasshopper was largely eaten. This and related grasshoppers, together with

cutworm-like caterpillars, formed almost nine-tenths of the food for the month.

The bluebird winters to a considerable extent in southern Illinois, where its food consists very largely of wild fruits, especially the berries of the mistletoe. A few beetles, bugs, and spiders fill out the winter bill of fare.

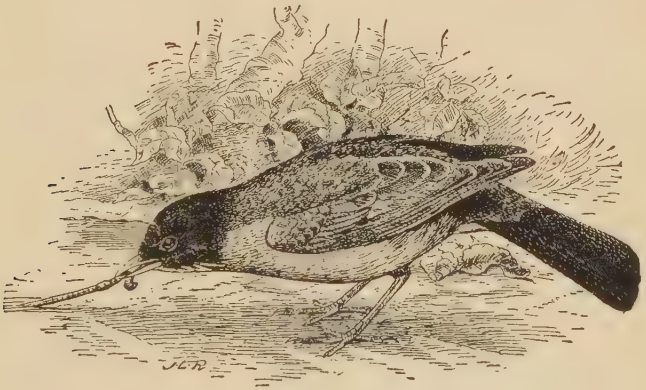
In the case of six young bluebirds yet in the nest, though well feathered, Dr. Judd found that the food consisted of "beetles, caterpillars, grasshoppers, spiders, and a few snails."

Although the bluebird eats a large percentage of predaceous and parasitic species that are often considered beneficial to man, the probabilities are largely in favor of the assumption that in devouring these the bird is assisting in keeping up a proper balance of organic forces, while in eating the insects injurious to crops it is doing a very great good. Professor Forbes estimates that "one hundred bluebirds at thirty insects each a day would eat in eight months about six hundred and seventy thousand insects. If this number of birds were destroyed, the result would be the preservation, on the area supervised by them, of about seventy thousand moths and caterpillars (many of them cutworms), twelve thousand leaf-hoppers, ten thousand curculios, and sixty-five thousand crickets, locusts, and grasshoppers. How this frightful horde of marauders would busy itself if left undisturbed no one can doubt. It would eat grass and clover, and corn and cabbage, inflicting an immense injury itself, and leaving a progeny which would multiply that injury indefinitely.

The bluebird is easily encouraged on the home grounds and will well repay a little trouble in furnishing nesting sites. It breeds readily in boxes and bird-houses, and if these are provided in abundance it seems likely that the numbers of the birds may be materially increased.

THE ROBIN.

With the exception of the English sparrow and possibly the crow, the economic status of no American bird has been discussed so fully and freely as that of the robin. Appearing early in spring and remaining late in autumn in regions where it does not reside throughout the year, commonly frequenting lawns and meadows, building conspicuous nests near the haunts of man, feeding freely upon the fruits of the garden and orchard, greeting the rising and the setting sun



THE ROBIN.
(*After Biological Survey.*)

with bursts of no mean melody,—these and other considerations have combined to render the robin familiar to every lover of the out-door world.

The robin obtains most of its insect food upon the ground, where it searches diligently for cutworms, white grubs, ground-beetles, and allied creatures. One of the most familiar sights of spring in the Northern States is that of dozens of robins searching the grass of lawns and meadows for food. These birds are decidedly gregarious, migrating in flocks of considerable size and remaining together in the

South during winter. Even during the breeding season the young birds and the old males gather nightly to roost in certain woods.[1]

The nest is so well known that we need here only mention its bulky size and the fact that at least two broods of four or five young each are reared during the season.

Several studies of the food of the robin are on record. One of the most authoritative of these is that of Professor S. A. Forbes, who made two separate investigations of the food in Illinois: the first included forty-one and the second one hundred and fourteen specimens. We have summarized the results in the latter case as follows: Ninety-nine per cent. of the food of eleven robins shot in February consisted of insects: cutworms and other caterpillars constituted fourteen per cent., and the larvæ of the white-winged Bibio[2]—a two-winged fly—seventy-six per cent. These Bibio larvæ have repeatedly been found in several widely separated States to form the principal food of the robin during spring. The larvæ live in colonies of a hundred or more individuals, and generally feed upon decaying organic matter, though some naturalists have stated that they are capable of doing serious injury to grass-lands. Professor Forbes took one hundred and seventy-five Bibio larvæ from the stomach of a single robin. In addition to these insects a very few beetles, grasshoppers, bugs, spiders, and thousand-legs had been eaten. About five per cent. of the food was estimated to consist of beneficial insects.

Thirty-seven per cent. of the food of nine March robins consisted of Bibio larvæ; cutworms and other caterpillars formed thirty per cent. The remaining food elements were

---

[1] For an interesting account of these little-known "robin roosts," see Bradford Torrey's book, "The Footpath Way," and Mr. Brewster's account in *The Auk*, October, 1890.

[2] *Bibio albipennis*, Say.

composed of scavenger-beetles, wire-worms, ground-beetles, grasshoppers, and sumach-berries. Six per cent. of the food was considered to belong to beneficial species and thirty-seven per cent. to those injurious. In April caterpillars formed one-fourth of the food and beetles forty-two per cent. "It is in this month that the bird makes its principal attack upon the predaceous beetles, which are represented by an average of seventeen per cent. eaten by eleven birds." A few Bibio larvæ, earthworms, Orthoptera, bugs, and sumach-berries had also been eaten. "The record of May is substantially a duplicate of the April list, except in a few particulars. The Bibio larvæ are replaced by seven per cent. of adult crane-flies and the ground-beetles drop to four per cent., the balance being almost replaced by the scavenger-beetles and leaf-chafers. . . . With June the robin revolutionizes his commissariat. The insect ratios, which have averaged ninety-five per cent. during the preceding months, now drop to forty-two, and remain at or below this point for the rest of the year; and this lack is compensated by the appearance of fifty-five per cent. of cherries and raspberries. The loss falls chiefly upon the two-winged flies and beetles, the former dropping from eleven per cent. to less than one and the latter from forty-four per cent. to fifteen. The fourteen July birds were evidently revelling in the fruit garden, raspberries, blackberries, and currants forming seventy-nine per cent. of the food." The partial disappearance of fruit supplies in August sent the robins back to insects, although the twenty birds taken during the month had eaten fifty-six per cent. of fruit. "Cherries made forty-four parts of the food of the month, eaten by fourteen of the birds, *but two-thirds of these cherries were wild.* Tame grapes made three per cent. of the food, berries of the mountain-ash about four per cent., and blackberries from the woods not far from five per cent." Cutworms, crickets, and grasshoppers are important insect elements for the month. In September fifteen

per cent. of winged ants were eaten and seventy per cent. of fruits, more than half of the fruits being grapes and the remainder berries of the moon-seed and mountain-ash. During October and later months large numbers of wild grapes were eaten.

Taking the year as a whole, insects form almost two-thirds of the food of the robin.

In the investigations of the United States Department of Agriculture three hundred and thirty stomachs of the robin have been examined. In the summary of the results, by Professor F. E. L. Beal, it is said that more than forty-two per cent. of its food consists of animal matter, chiefly insects, the rest being composed for the most part of small fruits and berries, largely of wild sorts. Noxious insects are believed to constitute at least one-third of the robin's food, grasshoppers alone forming ten per cent. of all the material eaten. "Vegetable food forms nearly fifty-eight per cent. of the stomach contents, over forty-seven per cent. being wild fruits, and only a little more than four per cent. being possibly cultivated varieties. Cultivated fruit amounting to about twenty-five per cent. was found in the stomachs in June and July, but only a trifle in August. Wild fruit, on the contrary, is eaten in every month and constitutes a staple food during half the year. No less than forty-one species were identified in the stomachs; of these the most important were four species of dogwood, three of wild grapes, four of greenbrier, two of holly, two of elder; and cranberries, huckleberries, blueberries, barberries, service-berries, hackberries, and persimmons, with four species of sumach and various seeds not strictly fruit."

Six robins shot in Nebraska by Professor Aughey had eaten two hundred and sixty-five Rocky Mountain locusts and eighty-four other insects. In Wisconsin Professor King examined the stomachs of thirty-seven specimens taken during the interval between March and October. "Five birds had eaten

eleven cutworms; three, five wire-worms; two, two hairy caterpillars; one, a hog-caterpillar of the vine; five, eight scarabæid beetles; two, two curculios; one, a click-beetle; one, an ichneumon-fly; two, two spiders; one, a millipede; two, two angle-worms; six, nine grasshoppers; two, eight grasshopper's eggs; one, a moth; three (young birds), pellets of grass; one, choke-cherries; two, black cherries; one, raspberries; one, grapes; one, sheep-berries; and one, berries of Indian turnip."

A few years ago we examined the stomach contents of a robin shot in Michigan between a row of cherry-trees and a raspberry-patch, both with ripe fruit. The stomach was almost filled with maggots, apparently belonging to some species of Anthomyia. Sixty of these larvæ were present.

The earliest extended investigation of the food of the robin was that made in Massachusetts about half a century ago by Professor J. W. P. Jenks. The study was continued throughout the year, and in the main the results obtained are very similar to those of Forbes summarized above. Bibio larvæ formed the principal food in early spring. Audubon states that in the South during winter the robins feed on the berries and fruits of the holly, sweet-gum, gall-berry, and pokeweed, as well as the caperia-berry, wild-orange berry, and the berries of the pride of India. The seeds of most of the berry-like fruits which the robin eats are not digested, and doubtless are widely scattered by the birds.

In 1891 Mr. E. V. Wilcox examined the stomach contents of nearly two hundred Ohio robins, taken during April, May, June, July, and August. "The great majority of the birds were killed on the Ohio Experiment Station grounds, about fifty being taken in other parts of the State." These grounds were largely devoted to the cultivation of cherries, strawberries, raspberries, blackberries, and other fruits. On this account it would seem probable that the percentage of fruit eaten would be greater than under ordinary field conditions, but the

fruit ratios are uniformly less than those obtained in Illinois by Professor Forbes. The results throughout are quite similar to those of the last-named investigator. The economic percentages are summarized as follows: Beneficial species (plants and animals), 52.4 per cent.; injurious species, 18.6 per cent.; neutral species, 28.9 per cent. It will be seen that these are much more unfavorable to the robin than Professor Forbes's results. The difference is largely due to the fact that the latter includes the months of February, March, and September in addition to the months covered by Mr. Wilcox; and also to the fact that in Illinois the Bibio larvæ were considered injurious, while in Ohio they were ranked as neutral. While these insects may now confine themselves to decaying organic matter, it seems, from the feeding habits of their allies, very probable that were the check the robin places upon their increase removed they would soon be compelled to resort to living vegetation for at least part of their diet, and become injurious. Consequently I think the robin entitled to credit for their destruction. The interesting point is brought out that "during the fruit season the robins shot in the station gardens were in the proportion of nine young to one old bird, and that the old birds took much more insect food than the young. While the young birds were feeding upon raspberries and other garden fruits, the old birds might be found more abundantly on newly mown meadows or in woodlands." Similar conditions have often been noticed in other localities.

To show how omnivorous a bird the robin is, Mr. Wilcox states that he found in the stomachs examined "caterpillars of all sorts, from the smooth geometrids, or spanworms, and cutworms to the more hairy kinds, such as the walnut caterpillar (*Datana angusi*) and even the common brown caterpillar (*Pyrrharctia isabella*). Coleoptera of several families were noted,—Staphylinidæ, Dermestidæ, Carabidæ, Scarabæidæ, Lampyridæ, Elateridæ, Otiorhynchidæ, Curculionidæ, Nitidulidæ, Chrysomelidæ, and Buprestidæ. There were found

adult and pupal Hymenoptera, adult and larval Diptera, Coleoptera, and Lepidoptera, adult and nymphal Heteroptera, Homoptera, and Orthoptera, adult Neuroptera (a small dragonfly), spiders, small snails, sowbugs, and Myriapods." In addition to this animal food, "a great majority of the fruits, cultivated and uncultivated, which have a juicy nutritious portion are included in the dietary of the robin."

Concerning the fruit-eating proclivities of the robin, Mr. W. J. Green, of the Ohio Agricultural Experiment Station, writes: "The capacity of the robin for berries is enormous, and when hundreds come at once the grower suffers serious losses. On the station grounds nearly all of the early raspberries and blackberries are taken by the robins, and only in the height of the season are there enough berries left to give the pickers a chance to earn fair wages. If left to themselves the robins would take the greater share of the black raspberries that grow on a plantation of more than an acre. Growers in other parts of the country have complained of losses quite as large."

The above accounts relate to the food of the adult robins. We have next to consider that of the nestlings. Properly to appreciate the importance of the latter, we must remember that as far north as Massachusetts three broods of nestlings are commonly reared; that from early spring till late in the summer each pair of old birds is engaged at least half of the time in providing food for four, five, or six ravenous birdlings; and that each of the latter probably requires more food while in the nest than does one of the adults during the same period. It seems to us that the chief claim of the robin upon man's favor rests upon these facts.

In 1884 we examined the stomach contents of six young robins from Michigan nests. The largest single element of the food consisted of cutworms and related caterpillars, which formed twenty-seven per cent. of the total dietary. Among other insects present were seven per cent. of beetles, includ-

ing curculios and ground-beetles, and various undetermined species. There were also present twenty per cent. of earthworms, one per cent. of snails, three per cent. of myriapods, and about thirty per cent. of grass blades. The latter seem almost always to be found in the stomachs of nestling robins; they may be introduced accidentally with the cutworms or possibly may have a dietetic value.

The food of fourteen nestlings examined by Beal consisted of caterpillars, locusts, grasshoppers, crickets, and beetles, with a few spiders, snails, and earthworms, and seven per cent. of berries of various kinds.

Professor King found the stomachs of three Wisconsin nestlings to contain wire-worms, white grubs, caterpillars, beetles, small seeds, and grass. Dr. T. M. Brewer watched the feeding of a set of young robins near his house, "and, so far as they were seen, the nestlings were fed until they left their nest entirely with the moths of the family Agrotiidæ or subterranean caterpillars, commonly known as cutworms." We suspect he meant to write the larvæ of the moths, instead of the moths themselves, although it is known that the latter are sometimes fed to the young.

In his admirable account of the nesting habits of the robin,[1] Professor Herrick states that the young are fed with grasshoppers, crickets, katydids, and angle-worms, as well as such fruits as choke-cherries, blueberries, and raspberries. Evidently for the nestlings, as for themselves, robins take the kind of food that is most abundant. Years ago Wilson Flagg watched a pair nesting near his house. They were rearing "a second brood in the month of July, when the soil was so greatly parched by drought that if robins lived only on berries and earthworms they must have starved to death. I had often seen the birds at a distance pecking vigorously upon the sward and then drawing out a worm. I knew that there were at this time no

[1] Home Life of Wild Birds, chap. iv.

earthworms near enough the surface to be within the reach even of the long-billed snipes. But when the bird was near enough I could distinctly see, by the form and appendages of the creature, that it was invariably a cutworm of a large species and of an olive-green color. The female bird was most industrious. She would carry off one of these grubs as often as once in five minutes, whenever I watched her movements, and very often she would have two in her bill at a time. One day close under my window, I saw her bear off three cutworms at once, all of which were taken before my sight in a space about a rod square."

The robin appears to be one of the birds that thrives fully as well under the conditions of modern agriculture as when the soil was owned by the red man. A knowledge of its feeding habits would lead one to expect this. In many localities it is believed that these birds are now more numerous than in earlier times. On the whole, there can be no doubt that it is an eminently useful bird, but it is equally certain that too often the fruit-grower alone has to pay heavily for services rendered to the community at large. In concluding his discussion of an elaborate investigation of the food of adult robins, Professor Forbes expresses his belief that the horticulturist cannot "sell his small fruits anywhere in the ordinary markets of the world at so high a price as to the robin, provided he uses proper diligence that the little huckster does not overreach him in the bargain." If this is true when the food of the adult alone is considered, it is much more so when the food of the nestlings is also taken into account. Nevertheless, we believe the fruit-grower should be allowed to protect his crops when necessary, doing so in such a way as to accomplish the greatest results with the least expenditure of robin life. But the indiscriminate destruction of the birds for food, "sport," or millinery purposes should be stopped, and the robbing of the nests should be properly punished.

THE CAT-BIRD.

While the cat-bird in most localities is much less abundant than the robin, it is almost as well known. It is a shyer species, commonly haunting shrubbery and underbrush in clearings and along running streams. It is a migrant and rarely winters very far north. The food of seventy Illinois specimens, shot during May, June, July, August, and September, was studied by Professor Forbes. Insects formed eighty-three per cent. of the food of twenty-two May examples: the remainder consisted of spiders, myriapods, and sumach-berries. "Among the insects were about equal ratios of ants, crane-flies, and beetles, the first composing eighteen per cent. of the food, the second nineteen, and the third twenty-three. Caterpillars formed twelve per cent. of the food, and about one-sixth of these were distinctly recognizable as cutworms. More than one-third of the beetles were Carabidæ, including specimens of Platynus and *Harpalus pennsylvanicus*." Four per cent. of Orthoptera were present, there being specimens of the snowy tree-cricket, grasshoppers, and young walking-sticks. "During the first part of June large numbers of ants and crane-flies were again eaten. Many May-beetles were also taken. During the last half of the month these insects were largely replaced by cherries, currants, raspberries, and strawberries." Three-fourths of the food of eleven July cat-birds consisted of small fruits, mostly (sixty-four per cent.) blackberries. Nine per cent. of beetles had been taken, most of them being predaceous. "It is clear that the cat-bird in midsummer eats only such insects as come in its way while regaling itself on the smaller fruits."

"The food-record of August resembles that of June, owing doubtless to the diminution of the smaller garden fruits at this time and to the fact that the wild fruits have not yet come into bearing. The insect percentages are therefore much larger than in July, and it is instructive to notice that

this increase is first apparent and most evident in the ratios of ants, an indication of the positive preference of the cat-bird for this food. Nearly one-half of the forty-six per cent. of insects eaten this month were ants." Among the beetles eaten was one striped cucumber-beetle, and among the bugs were a few chinch-bugs. Blackberries formed the staple fruit element. During the first half of September cherries, wild fruits, and grapes formed seventy-six per cent. of the food. The final percentages of the food for the five months are: beneficial, forty-one; injurious, fifteen; neutral, forty-four.

Five cat-birds examined in Nebraska by Aughey had eaten one hundred and fifty-two Rocky Mountain locusts. Twenty-five specimens shot during May in the Illinois orchard where canker-worms were at work, and studied by Professor Forbes, had eaten fifteen per cent. of canker-worms. This author also reports having seen cat-birds "busily scooping out the fairest side of the ripest early apples, unsurpassed in skill and industry at this employment by the red-headed woodpecker or the blue-jay."

Evidently there is room for improvement in the economic status of the adult cat-bird. But the dietary sins of the parents are largely atoned for by the food of the young. In 1884 we examined the stomach contents of three Michigan nestlings of this species: ninety-five per cent. of the food consisted of insects; two per cent. of spiders; and three per cent. of Myriapods. Sixty-two per cent. of the food consisted of cutworms; eleven per cent. of ground-beetles; four per cent. of grasshoppers; three per cent. of May-flies, and two per cent. of dragon-flies. The large proportion of cutworms strongly favors the usefulness of the species. Professor Herrick's observations[1] show that dragon-flies, caught just as they emerge from the nymph state, are commonly fed the nestlings, as are also "insect larvæ, beetles, moths, millers,

[1] Home Life of Wild Birds, chap. viii.

203301

and a great variety of smaller insects, varied with liberal courses of strawberries." Fourteen nestlings studied by Judd had eaten but four per cent. of fruit, their diet being chiefly ants, beetles, caterpillars, spiders, and grasshoppers.

While the cat-bird by no means deserves the cruel and senseless persecution it too often receives, it seems to us that the fruit-grower should be allowed to protect himself from ruinous injury by it. We have no doubt that, on the whole, the benefit which it does is much greater than the harm, and its destruction should never be permitted except when necessary to save precious crops. Professor F. E. L. Beal believes that "cultivated fruits can be protected from the cat-bird by the simple expedient of planting wild species or others which are preferred by the birds." Dr. Judd has shown that Russian mulberries are preferred to cherries by these birds.

OTHER THRUSHES.

Every farmer's boy in the Middle States has heard the song of the Brown Thrush or Thrasher. In many respects its vocal powers excel those of any of the northern birds that are known by every body. It is a shy creature, haunting shrubbery and underbrush and skulking away on the approach of man. When scratching the dry leaves or running over the surface of the ground, the rustling noise it makes is surprising: in the palmetto brush of southern Florida we have often been led to think some larger animal was present. It is a regular migrant, breeding in the north and wintering south.

We are indebted to Professor Forbes for quite a full knowledge of the food of the brown thrush. Two separate investigations were made, the first including twenty-eight birds shot in Illinois during April, May, June, and July, and the second sixty-four specimens covering the six months from April to September. The feeding habits for this time are thus recapitulated.

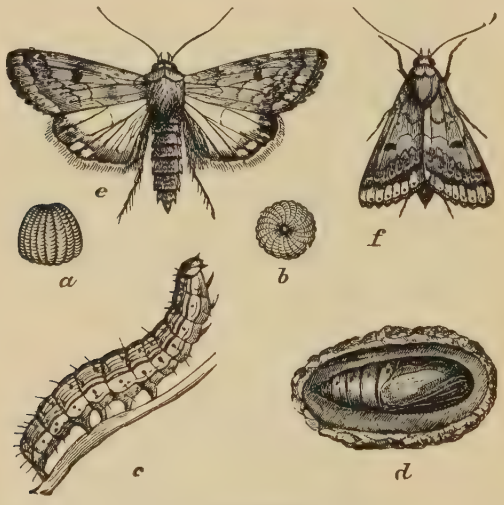
"The brown thrush, arriving in April, finds nearly one-

half of its food in fragments of corn and other grains and seeds picked from the droppings of animals. This curious habit it maintains throughout the year, evidently taking this food from preference as well as from necessity. In fact, I have often found these vegetable fragments associated with blackberries in the food. After April this element averages about sixteen per cent. throughout the season. Insects amount to about half the food for each month, except in May, when

THE BROWN THRUSH.
(*After Biological Survey.*)

they rise to three-fourths, and in July, when they drop to one-fourth. The excess in May occurs at the time of the greatest number and activity of the beetles, and the diminution in July coincides with the period of the greatest abundance of the small fruits. One-half the insects eaten are beetles, which stand at one-fourth of the food in April and June, rise to one-half in May, and fall to about one-eighth in July and August. Half the beetles of the year are Scarabæidæ, chiefly June-beetles and Euryoma, all taken previous to July. Nearly one-fourth of the beetles are Carabidæ, which remain at about five per cent. of the food, except in May, when they rise to ten per cent. Although the ratios

of spring-beetles and snout-beetles are but two per cent., the numbers eaten are of some significance. My notes show that these birds were eating each at the daily rate of one and one-half curculios, and consequently had averaged a total of about two hundred and fifty to each thrush for the season. The brown thrush takes ants more freely than the robin, but eats comparatively few caterpillars; seven per cent. of each were found in the food of the year. Diptera are taken in very trivial quantity and Hemiptera in moderate numbers only.



BOLL-WORM.

a, *b*, eggs, side view and top view, magnified; *c*, larva; *d*, pupa, in cocoon; *e*, moth with wings expanded; *f*, moth with wings closed. (*After Riley.*)

This bird eats thousand-legs mere freely than the robin, especially in early spring. In the garden it plays a part very similar to that of the other thrushes, but is less mischievous, on the whole. Its average of the edible fruits for June, July, and August is thirty-eight per cent., as against sixty per cent. of the robin and forty-nine per cent. of the cat-bird. It relishes the whole list of garden fruits, and later in the season resorts to the wild fruits of the woods and thickets."

The nestlings of this species are fed upon spiders and insects, especially the various grasshoppers and caterpillars.

The famous Mocking-bird, whose music is to Americans much what that of the nightingale is to Europeans, is commonly found in the Southern States. As a rule, it is rare north of latitude 40. Its food appears to be much like that of the other thrushes, consisting of about equal proportions of insects and various wild and cultivated fruits. The young appear to be fed chiefly upon insects, among which the moth of the cotton-boll-worm deserves special mention.

In the North the Wood-Thrush is the most famous songster of its family. It is common, but not abundant, in most of the Eastern States, north to New England. It is usually a shy bird, haunting woodland shrubbery, but there are indications that it is becoming more familiar with man, and there seems good reason for hoping that in time it will be much more commonly seen upon the home grounds. Professor Forbes's studies of the food of twenty-two Illinois birds show that it is one of the most useful of the thrushes, eating large numbers of injurious insects and comparatively little fruit. One specimen had stuffed itself with rose-beetles (*Macrodactylus subspinosus*) and others had eaten large numbers of ants and crane-flies. Insects as a whole formed seventy-one per cent. of the food. Of course every one is eager to encourage the advances of this beautiful songster.

The economic relations of the other thrushes—such as the Hermit, Alice, or Swainson's—appear to be very similar to those of the wood-thrush. The hermit is credited—or rather debited—with the destruction of many predaceous beetles during its northward migration, and the other two species mentioned are unusually fond of ants and caterpillars.

In summarizing the food of the family of thrushes as it occurs in Illinois, Professor Forbes says: "Sixty-one per cent. of the food consists of insects, one per cent. of spiders, two per cent. of Myriapods, and thirty-two per cent. of fruits,

eleven per cent. being blackberries, eight per cent. cherries, one per cent. currants, and five per cent. grapes. Thirty parts of the food consist of injurious insects and eight parts of beneficial species, while twenty-six parts consist of edible fruits." This, however, refers only to the adult birds, the food of the young not being sufficiently known to be included in the estimate. All the observations on record indicate that the nestlings of thrushes are fed upon insects, especially smooth caterpillars like the cutworms, so that there is little doubt that this factor would largely increase the already conclusive evidence as to the great value of this splendid family.

The charming little kinglets of the family *Sylviidæ* are among the most delightful of the pygmy birds. They frequent the tops of tall trees so constantly that they are seldom seen by most people. Two species are rather common in our Northern States, the GOLDEN-CROWNED and the RUBY-CROWNED KINGLETS. Both are insectivorous in their feeding habits.

THE GOLDEN-CROWNED KINGLET.

CHAPTER IX.

THE NUTHATCHES, TITMICE, CREEPERS, AND WRENS.

THE NUTHATCHES.

The nuthatches (*Sittinæ*) comprise a small group of creeping birds which inhabit woodlands chiefly, although they often visit trees in orchards and groves or along the highway. Most of their food consists of insects gathered from the bark of trees, but part of it is composed of seeds of various kinds. They are compact flattened birds, with plumage of modest colors and hard barbed and pointed tongues. Four species and one variety occur in the United States, a common form in the Northeast being the White-breasted Nuthatch, which in the Middle and Western States is replaced by a variety with a more slender bill. This bird is frequently abundant in woodlands, and moves actively about over trunks and branches in search of food. Professor King examined the stomach contents of twenty-five Wisconsin specimens, and found that fourteen of them had eaten beetles, including elaters and longicorns, while others contained ants, caterpillars, and beetle-grubs, a spider and a chrysalis, a few small toadstools, some acorns, and a little corn. Four Illinois specimens had eaten beetles of various kinds, some of them being lady-beetles.

The food of this species in winter and spring was made the subject of a special study by Professor E. D. Sanderson. "During the winter the larger proportion of the food was composed of seeds, which gradually decreased as insect life became more abundant." Seeds of Indian corn, ragweed, and wild sunflowers were recognized; the insects were largely in egg or larval stages. In spring nearly eighty per cent. of the food consisted of insects, chiefly adults. No traces of acorns were found in the stomachs examined. From

these studies Professor Sanderson reaches the conclusion that this species is "either absolutely neutral or of comparatively small economic importance,"—a conclusion which, it seems to us, is by no means warranted by his results. During the spring, he writes, "Hymenoptera were found in considerable numbers, *all being beneficial.*" Probably it is on this account that the usefulness of the birds is doubted. But we believe, as indicated in Chapter VI., that investigators err in saying that all parasitic insects are beneficial.

The nest of this bird is built in a hole in a tree, the cavity being sometimes excavated by the nuthatch and sometimes by another bird or a falling limb. The rapid destruction of forests and the thinning out of dead trees in orchards and woodlands must reduce the available nesting sites and thus tend to lessen the numbers of the nuthatches. There is some reason for supposing that if suitable artificial nesting places were provided in orchards these birds would breed in them. It is an experiment well worth trying.

The Red-breasted or Canada Nuthatch is much rarer than the last-named species in many parts of the United States, although the two birds seem to be very similar in their feeding habits. It breeds in holes and stumps, and feeds on beetles, ants, and other small insects. In Nebraska it has been seen eating young grasshoppers.

THE TITMICE.

The titmice, or chickadees, which with the nuthatches and wren-tits form the family Paridæ, are represented in North America by nearly a score of species and varieties, the great majority of which, however, are rare or only locally distributed. The common Chickadee, or Black-capped Titmouse, is much the most familiar species in the Eastern States, remaining with us throughout the year. It takes a great variety of food, gleaning through the winter from the bark and twigs of both deciduous and evergreen trees, and in summer

devouring insects of many kinds. In a canker-worm infested orchard sixty-one per cent. of the food of two chickadees consisted of these caterpillars, while injurious beetles constituted the remainder.

In a recent investigation of the winter food of the chickadee, we studied[1] the stomach contents of forty-one specimens taken during November, December, January, February, and March. The results as a whole show that more than half of the food of the chickadees during winter consists of insects, a very large proportion of which are taken in the form of eggs. About five per cent. of the stomach contents consisted of spiders or their eggs. Vegetation of various sorts made up a little less than a quarter of the food, two-thirds of which, however, consisted of buds and bud-scales that were believed to have been accidentally introduced with plant-lice eggs. These eggs made up more than one-fifth of the entire food and formed the most remarkable element of the bill of fare. This destruction of the myriads of eggs of plant-lice which infest the fruit, shade, and forest trees is probably the most important service the chickadee renders during its winter residence. More than four hundred and fifty eggs sometimes occur as the food of one bird in a single day. On the supposition that one hundred were eaten daily by each of a flock of ten chickadees, there would be destroyed one thousand a day, or one hundred thousand during the days of winter, a number which we believe to be far below

THE CHICKADEE, OR BLACK-CAPPED TITMOUSE.

[1] New Hampshire College Agricultural Experiment Station, Bull. 54.

the actual average, could we determine it precisely. Insects' eggs of many other kinds were found in the food of the chickadee; many of these it was impossible to recognize, but there was no difficulty in identifying the eggs of the common American tent caterpillar and of the fall canker-worm, the eggs of which remain upon the trees through the winter. There were also present the eggs and egg-sacs of many spiders of kinds commonly occurring under loose bark. While spiders as a class are doubtless beneficial creatures, the destruction of some of them is not in our opinion seriously detrimental to the usefulness of the chickadee. The larvæ of several different kinds of moths were also found. One of the most abundant species was believed to be the common apple-worm, the larvæ of the codling moth. The bark-beetles of the family Scolytidæ, which are destructive to forests all over our country, were also freely eaten by the chickadees. The hairy skins of the fruits of the common wild sumachs were among the most abundant elements of the vegetable food present. The edible portion of these fruits is evidently eaten to a considerable extent throughout the winter and early spring. Another common element of the food appears to consist of the curious little fruits of the bayberry or waxberry myrtle—an abundant shrub along the sea-coast. In winter chickadees have been observed to hide away surplus food, to eat at a later time.

A careful study of the food of the chickadee in Michigan has also been made by Professor E. D. Sanderson, with results very similar to those recorded above. As an indication of the usefulness of these birds, he writes: "If fifty-five insects were consumed per day by each bird, as will be shown to be the case, three hundred and eighty-five would be consumed per day by a flock of seven, which is believed to be a fair average for each square mile: this would be about one hundred and thirty-seven thousand five hundred per year in each square mile. Thus upon the land surface of Michigan

there will annually be about eight thousand million insects destroyed by chickadees alone. Surely no mean number."

The closely related Long-tailed Chickadee of the Western States feeds largely upon grasshoppers when the latter are abundant. The Carolina Titmouse of the Southern States appears to have food-habits similar to those of its northern representative, except that through the winter months it doubtless finds a larger percentage of insect food.

THE CREEPERS.

The small family of creepers (*Certhiidæ*), of which only about a dozen species are known in the entire world, has but one representative in the United States. These birds in outward appearance and habits are suggestive of the woodpeckers. They have rigid tail-feathers and a slender decurved bill, with toes adapted to running up the sides of trees.

The Brown Creeper is the common American representative of this family. It is a small bird, very restless and active, which may often be seen by bird-lovers going in spirals up tree trunks, but never hanging head downward like the nuthatches. It nests behind loose bark on the trunks of trees, and in most of the Northern States may be found throughout the year. Very few precise determinations of its food have been made: three stomachs examined by King contained small beetles and other insects, and Nelson reports that he has seen several of these creepers on the sides of a house searching for spiders. In June, 1895, Aughey saw two parent birds bring to a nest of young twenty-seven locusts in an hour. In Maryland, Judd found that one bird had eaten beetles, sawflies, flying ants, spiders, and seeds of the scrub pine.

There can be no doubt that this is a very useful little bird, deserving all possible encouragement.

THE WRENS.

The elegant little wrens, in their suits of brown and drab, belong to a small family (*Troglodytidæ*) of highly insectivorous birds. The saucy HOUSE-WREN is much the most familiar representative. It occurs throughout the United States, from the Atlantic to the Pacific, the western being considered a

THE HOUSE-WREN.
(*After Biological Survey.*)

distinct geographical race. In the Northern States it is migratory, spending the winter in the South. It nests about barns and dwellings in almost any situation, and is easily encouraged by putting up nesting-boxes. The house-wren is a very useful bird to have searching constantly for insects in the shrubbery of the ornamental grounds, the trees of the orchard, or the vines of the garden. Its diet appears to be exclusively insectivorous; including on its bill of fare larvæ and caterpillars of many kinds, as well as ants, grasshoppers, gnats, beetles, bugs, spiders, and myriapods. Professor Aughey repeat-

edly observed both this and other wrens carrying young locusts to their nestlings. Nearly half the food of several specimens shot in an orchard infested by canker-worms consisted of these pests. Fifty-two stomachs were examined at the United States Department of Agriculture, the record showing "that ninety-eight per cent. of the stomach contents was made up of insects or their allies, and only two per cent. was vegetable, including bits of grass and similar matter, evidently taken by accident with the insects. Half of their food consisted of grasshoppers and beetles; the remainder, of caterpillars, bugs, and spiders."

The house-wren is accused,[1] apparently on good evidence, of sometimes pecking holes in the eggs of chipping-sparrows and throwing them out of the nest. Probably this is a special habit of certain birds, due to unusual conditions, although it may well lead bird-lovers to watch the wrens to see how general it is.

A mother wren observed by Judd made one hundred and ten visits to her nest in feeding her young in four hours and thirty-seven minutes, feeding them one hundred and eleven insects and spiders.

Two species of Marsh-Wrens are common in the United States, the long-billed and the short-billed. They especially haunt swampy ground, the former building an enormous globular nest among the reeds. Both species feed upon insects, spiders, and snails. Of fourteen Wisconsin specimens of the long-billed marsh-wren, one had eaten "one ant; one, a caterpillar; one, three beetles; three, three moths; one, a small grasshopper; one, five grasshoppers' eggs; one, a dragon-fly; and one, a small snail." (King.) Five Maryland specimens had eaten spiders, beetles, bugs, leaf-hoppers, flies, four-winged parasites, and ants, the first two forming the major portion of the food.

---

[1] Bird Lore, ii. 90.

CHAPTER X.

THE WARBLERS AND THE VIREOS.

THE WOOD WARBLERS, OR AMERICAN WARBLERS.

The beautiful-plumaged American warblers (*Mniotiltidæ*) form next to the largest family of our native birds. Nearly all of them are small. As a group they are abundant and widely distributed, migratory, and insectivorous. In many species the plumage varies greatly with the age and sex. There are about sixty North American representatives of the family. "With tireless industry do the warblers befriend the human race," writes Dr. Elliott Coues; "their unconscious zeal plays due part in the nice adjustment of nature's forces, helping to bring about that balance of vegetable and insect life without which agriculture would be in vain. They visit the orchard when the apple and pear, the peach, plum, and cherry are in bloom, seeming to revel carelessly amid the sweet-scented and delicately tinted blossoms, but never faltering in their good work. They peer into the crevices of the bark, scrutinize each leaf, and explore the very heart of the buds to detect, drag forth, and destroy these tiny creatures, singly insignificant, collectively a scourge, which prey upon the hopes of the fruit-grower, and which if undisturbed would bring his care to naught. Some warblers flit incessantly in the terminal foliage of the tallest trees; others hug close to the scored trunks and gnarled boughs of the forest kings; some peep from the thicket, the coppice, the impenetrable mantle of shrubbery that decks tiny water-courses, playing at hide and seek with all comers; others, more humble still, descend to the ground, where they glide, with pretty, mincing steps and affected turning of the head this way and that, their delicate

flesh-tinted feet just stirring the layer of withered leaves with which a past season carpeted the ground."

The Black and White Creeping Warbler, sometimes called the black and white creeper, is abundant in most wooded portions of eastern America, extending westward to Dakota and Nebraska. It resembles the creepers and nuthatches in its manner of taking food, searching every cranny and crevice of the bark of trees for the insects sheltered there, occasionally chasing for short distances moths or other creatures frightened from their hiding-places; and sometimes scrutinizing the foliage, like other warblers. The nest is placed on or near the ground, very often on a rocky ledge. Four or five young are reared. The insects eaten by the bird belong mostly to species of small size.

Seventeen Wisconsin specimens had eaten five ants, twenty small measuring worms and one other caterpillar, four moths, five two-winged flies, one curculio and fifteen other beetles, seven bugs, a caddis-fly, and a small snail, besides more than a hundred insects' eggs. One Nebraska bird had swallowed forty-one locusts and twelve other insects, together with a few seeds.

The Blue Yellow-backed Warbler is a beautiful little bird which spends much of its feeding time among the topmost twigs of the tallest trees. It is common in eastern America and is found as far west as the Rocky Mountains. In New England it has been observed feeding on May-flies, measuring worms, and spiders; in Wisconsin six small insects were taken from a single stomach, and in Nebraska it has frequently been seen picking up locusts and other insects. A picture of it is shown in the frontispiece of this book.

The Nashville Warbler is found, occasionally at least, throughout almost the whole of North America, specimens of it having been taken as far north as Greenland, as far west as Utah, Nevada, and California, and as far south as Mexico. Its chief distribution, however, is in the region east of the

Mississippi River, where it is a regular migrant, breeding as far south as the northern counties of Illinois and the central portion of New England. The nest is placed on the ground. The only food records that we have show that two Wisconsin specimens had eaten four small green caterpillars and some other insects not identifiable, and that one Nebraska fledgling had devoured twenty-one locusts and several other insects, while the adult birds have frequently been seen feeding on locusts.

The Tennessee Warbler is a very interesting migratory species that passes regularly and abundantly through the Mississippi Valley States during its spring and autumn migrations. It also occurs sparingly west to the Rocky Mountains and east to the Atlantic Ocean. It breeds in the far North and winters, in part at least, in South America. It searches diligently for the insect mites that infest the foliage of trees, seeming to have a special fondness for aphides, forty-two of which have been taken from the stomachs of three of these birds. Among the other food elements of thirty-two specimens there were found two small Hymenoptera, thirteen caterpillars, fifteen two-winged flies, thirteen beetles, thirty-five small bugs, and eleven insects' eggs. Four-fifths of the food of one bird shot in an orchard infested by canker-worms consisted of these pests. Tennessee warblers have also been seen feeding on small grasshoppers.

This, however, is one of the very few warblers against which a charge has been brought by the fruit-growers. In some sections it is known as the "grape-sucker," because it punctures ripe grapes with its little beak, presumably to get at the juice. Testimony on this point appears to be conclusive, and considerable injury occasionally results. There can be no doubt, however, that in the aggregate the bird does vastly more good than harm.

The Yellow-rumped Warbler, or Myrtle-Bird, is an exceedingly hardy little creature, often enduring the rigors of a

New England winter when its congeners are basking in the sunshine of the South. It is distributed over a large North American range, and is abundant in all sorts of situations, especially during the spring and autumn migrations. It breeds regularly in the far North, commonly nesting, however, in the northern tier of States and in southern Canada. According to Ridgway, it is a common winter resident in southern Illinois. Of twenty-one specimens studied by King, "one had eaten a moth; two, twenty-one caterpillars, mostly measuring worms; five, fourteen two-winged flies, among which were three crane-flies; fifteen, forty-eight beetles; one, four ichneumon-flies; one, a caddis-fly; and one, a spider." Our own studies[1] of many specimens show that in autumn three-fifths of its food consists of myrtle-berries, the remainder being largely insects, while in spring the insect ratios are much greater.

The Yellow Warbler, or Summer Yellow-Bird, is probably the best-known member of its family. It seems perfectly at home throughout the whole of North America, from the tropical regions of the South to the arctic lands of the North. It is a familiar and confiding bird, associating freely with civilized man, and building its neat nest of vegetable fibre in the trees of the orchard, park, family residence, and public thoroughfare. Three or four eggs are usually deposited in the nest, and when an additional one is left by a skulking cow-bird, the warblers—with a wisdom beyond their size—sometimes add another story to the nest and begin again their domestic duties, leaving the stranger egg and if necessary some of their own to go unhatched.

The food habits of the yellow warbler are all that could be desired. It freely visits farm premises and feeds on minute insects of many kinds. Two-thirds of the food of five Illinois

[1] Dearborn and Weed, Tech. Bulletin No. 3, N. H. C. Exp. St., Food of the Myrtle-Warbler.

specimens consisted of canker-worms, and most of the remainder was an injurious beetle. An equal number of Wisconsin birds contained small caterpillars and beetles; and from various other specimens spiders, myriapods, moths, bugs, flies, grasshoppers, and other insects have been taken.

The Black-throated Green Warbler, which is especially characterized by its jet-black chin, throat, and breast, is abundant in New England and extends westward to Ne-

THE MAGNOLIA WARBLER.

braska, breeding in pine trees throughout the northern portion of its range. Its food is obtained among the branches of tall trees, largely while upon the wing, and consists of a great variety of small insects, including caterpillars and larvæ of many kinds, curculios and other beetles, small bugs, and various Hymenoptera. An idea of the number of insects it

consumes may be obtained from the statement that the stomachs of five birds taken in Nebraska during June contained one hundred and sixteen small locusts and one hundred and four other insects, an average of forty-four to each bird. Seventy per cent. of the food of one Illinois specimen consisted of canker-worms.

The beautiful American Redstart is a much commoner species in most of the Northern States than would be supposed by those who have paid no special attention to the study of birds. Living amidst the foliage of trees, it is seldom seen except by those looking for the warblers found in such situations. The redstart is "the flycatcher of the inner tree-tops," capturing on the wing the numerous insects that flit about among the branches and occasionally taking a caterpillar hanging by a thread or crawling on a twig. The food of the few specimens that have been critically examined consisted of small two-winged flies, a few parasitic Hymenoptera, an occasional small bug, and some minute larvæ. Seven Nebraska specimens had eaten one hundred and sixty-one small locusts and one hundred and seventeen other insects. The young are fed with moths and other insects caught when upon the wing.

The handsome little Maryland Yellow-throat, in its typical form or that of a subspecies, is found throughout the United States, from the Atlantic to the Pacific oceans, and in many localities is one of the most abundant of the warblers. It especially frequents the shrubbery about standing or running water, where it can be found throughout the summer busily searching for insect food. It often visits orchards, where canker-worms and other caterpillars are greedily devoured, these forming in three cases on record four-fifths of its food. The little case-bearing caterpillars of the genus Coleophora and its allies are often eaten, while butterflies, moths, two-winged flies, beetles, grasshoppers, leaf-hoppers, bugs, dragon-flies, Hymenoptera, and insects' eggs are all included on the bill of

fare. The young are sometimes fed with small grasshoppers, and these insects are a favorite item of food with the adult birds.

Like the yellow warbler, this species sometimes outwits the cow-bird by its intelligence. Mr. A. W. Butler thus describes the three-storied nest of a yellow-throat in his possession: "In the original nest had been deposited the egg of a cow-

BUTTERFLY CAUGHT BY MARYLAND YELLOW-THROAT.

bird, then within that nest and rising above it the yellow-throat had built another nest, which also became the depository of the hope of offspring of this unnatural bird; again the little warbler constructed a third nest upon the other two, burying the cow-bird's egg, and in this nest laid her complement of eggs."

These examples will suffice to make manifest the fact that the warbler family is one of extraordinary economic value, the members of which are immensely useful in checking noxious insects and with very few exceptions have no injurious habits. It is particularly gratifying that these charming birds, whose song and plumage draw to them the good will of all intelligent people, should show so well that utility and beauty are not always dissociated.

Photographed from life by Dr. R. W. Shufeldt.

RED-EYED VIREO. YOUNG.

THE VIREOS, OR GREENLETS.

The vireos, or greenlets, are universally recognized as among the sweetest of feathered songsters. They are small birds, modest in manners and dress, very different from the shrikes, to which the ornithologists state that they are closely related. This is exclusively a New World family, composed of half a dozen genera and a little over half a hundred species: only one of the former, the genus Vireo, and thirteen of the latter occur in the United States. Of these thirteen species about half are common over a considerable area. In color our forms are mostly greenish olive or gray above and white or yellow below. They build slightly pendent nests in trees, migrate southward in autumn, and are almost exclusively insectivorous. They are more often heard than seen. "Clad in simple tints that harmonize with the verdure," writes Dr. Coues, "these gentle songsters warble their lays unseen, while the foliage itself seems stirred to music. In the quaint and curious ditty of the white-eye, in the earnest, voluble strains of the red-eye, in the tender secret that the warbling vireo confides in whispers to the passing breeze, he is insensible who does not hear the echo of thoughts he never clothes in words."

The Red-eyed Vireo seems to be the most abundant and widely distributed species of the genus. It is found in all the States except those of the extreme West, and in summer sometimes migrates as far north as Greenland. It prefers woodlands to the cultivated fields, but frequently finds its way to parks and orchards. It commonly seeks its food among the foliage and branches of trees and shrubs, sometimes chasing moths and other flying insects for short distances on the wing. It is universally recognized as a great insect-eater. An excellent idea of its food may be obtained from Professor King's studies of fifty-four Wisconsin specimens: "From the stomachs of eighteen of this species were taken

fifteen caterpillars; five other larvæ; eight beetles, among them five weevils and one long-horn; seventy heteropterous insects, among them sixty-seven chinch-bugs; sixteen winged ants; one ichneumon (?); five dragon-flies; two dipterous insects, one of them a large horse-fly (*Tabanus atratus*); three small moths; two grasshoppers; one aphis; one chrysalid; two spiders; and seven dogwood-berries. Of thirty-six other specimens examined, fifteen had eaten caterpillars; two, other larvæ; nine, beetles, among them two lady-bird beetles; three, grasshoppers; two, ants; two, moths; four, unidentified insects; and seven, fruits or seeds, among which were raspberries, dogwood-berries, berries of prickly ash, and sheepberries." During locust outbreaks in Nebraska four-fifths of the food of this vireo has been found to consist of these insects. Of his studies of the food of the young of this species, Professor Herrick writes: "Grasshoppers, katydids, green larvæ, beetles, and bugs of many kinds were served again and again; but it would be a mistake to suppose that there was no fruit to vary this diet. Upon the third day the mother brought a ripe red raspberry, its juice fairly streaming down her bill, and after a few beetles had been taken she appeared with a large blackberry. Fruit was served to the young about half a dozen times in the course of four hours during which watch was kept on this particular day, but I had not seen a single berry brought to the young before this time." Professor Beal found that nestlings three days old had been fed with spiders, sphinx caterpillars, butterflies, assassin-bugs, and tree-hoppers.

The Warbling Vireo frequents cultivated fields, orchards, and the vicinity of houses, as well as the wilder woodlands. It is an abundant species in most States and is highly insectivorous. Its food consists chiefly of caterpillars, including such destructive species as the canker-worm, beetles of various kinds, among them the twelve-spotted cucumber-beetle and occasionally a lady-bird, crane-flies and other

two-winged flies, grasshoppers, bugs, and sometimes dogwood-berries. The young are known sometimes to be fed with grasshoppers. Canker-worms formed forty-four per cent. of the food of three specimens shot in an orchard infested by these pests.

The Yellow-throated Vireo is a larger bird than either of those above mentioned. It is common in the eastern regions of North America, and feeds on caterpillars, including measuring worms, moths, weevils and other beetles, grasshoppers, leaf-hoppers, and various flies. It evidently is a highly beneficial bird.

The White-eyed Vireo is abundant in the Eastern States as far north as Massachusetts, and is occasionally found as far west as the base of the Rocky Mountains. It usually haunts clearings where there is much underbrush. Dr. Brewer reports that it feeds on canker-worms, and De Kay says it eats insects and berries. No precise records of the examination of the stomach contents appear to have been published, but its diet is probably similar to that of the other species of the genus. Judd summarizes[1] the food of ten specimens of this species along with that of fifteen specimens of other species. Ninety-one per cent. of the food of the twenty-five vireos consisted of insects and nine per cent. of the fruit of mulberries and sassafras.

---

[1] Birds of a Maryland Farm, U. S. Biol. Surv., Bull. 17, p. 102.

CHAPTER XI.

THE SHRIKES, WAXWINGS, SWALLOWS, AND TANAGERS.

THE SHRIKES, OR BUTCHER-BIRDS.

It is difficult to arrive at a satisfactory conclusion concerning the economic status of our North American shrikes (*Laniidæ*), of which there are two well-defined species, the great northern shrike and the loggerhead shrike. They are birds of extraordinary habits and feed upon an unusual variety of animal life. On the one hand it is clear that they devour large numbers of injurious insects, birds, and mice, and on the other hand that they destroy many beneficial birds. The balance of evidence, however, seems to show that on the whole the shrikes are of economic value. The complexity of the problem is increased by their peculiar habit of impaling many of their victims upon thorns, often leaving them there indefinitely. Many explanations of the origin of this habit have been suggested. The most plausible one seems to be that the victims are thus spitted for convenience in tearing up preparatory to eating, Dr. Judd having shown that this is necessary on account of the comparative weakness of the shrike's feet as grasping organs.

The Great Northern Shrike is a bold and fearless bird. "Appropriating to himself sufficient territory, where no other bird may safely intrude, he becomes the terror of the neighborhood, and woe to the unlucky finch or warbler that ventures to trespass on these hunting-grounds. Like a veritable sentinel on guard, the shrike stands in wait upon his chosen spot, ready to pounce with unerring aim upon the first little bird that may dare to rustle in the nearest bush." (Coues.) Besides the small native birds that are thus destroyed, the shrikes are known to attack the imported English sparrow.

On this account it has been recommended that they be protected by law. Shrikes also feed upon shrews and mice and many kinds of insects, including grasshoppers, caterpillars, crane-flies, and ground, tiger, carrion, and leaf beetles. Dr. S. D. Judd, who has made a careful study of the food of this species, writes: "The present investigation shows that beneficial birds form less than one-fourth of the food of the butcher-bird. It also shows that, in addition to being an enemy of

THE GREAT NORTHERN SHRIKE.

mice, it is a potent check on the English sparrow and on several insect pests. One-fourth of its food consists of mice; another fourth, grasshoppers; a third fourth consists of native sparrows and predaceous beetles and spiders, while the remainder is made up of English sparrows and species of insects most of which are noxious."[1] The young are fed very largely with grasshoppers, though mice and birds are sometimes given them.

The Loggerhead Shrike is a smaller bird than the last. In some of its racial forms it is found very generally throughout

[1] Div. Biol. Surv., U. S. Dept. Agr., 1898, Bull. No. 9, p. 20.

the country in summer, retiring southward at the approach of winter. Inhabiting a warmer climate than its northern relative, it is able to subsist more largely upon insects.

In eighty-eight stomachs reported by Dr. Judd,[1] only seven birds were found. Mice formed fifty per cent. of the winter food, or sixteen per cent. of that for the whole year. Beetles and their larvæ constituted twenty per cent., of which half were predaceous. Caterpillars, grasshoppers, wasps, and spiders were all found in considerable numbers. The nestlings are fed mainly upon insects, with an occasional mouse or small bird.

Although the loggerhead shrike destroys a few birds and beneficial insects, these seem to be more than compensated for by its destruction of mice and noxious insects.

THE WAXWINGS.

The beautiful family of waxwings (*Ampelidæ*) is represented in North America by three species, only one of which is at all common and widely distributed. Of the other two, one, the Bohemian waxwing, is found in the far North, coming to the southern line of Canada in the winter, and the other, the shining fly-snapper, occurs in the Southwestern States. Another species included by some ornithologists in this family is Townsend's fly-catching thrush, a peculiar bird found in the Rocky Mountain region.

The only member with which we are especially concerned in the present connection, however, is the handsome CEDAR WAXWING, or CEDAR-BIRD, sometimes also called the CHERRY-BIRD. This "gem of ornithological beauties" is found in nearly all the United States and throughout a large part of Canada. It commonly goes in small flocks which wander from place to place in search of food, and is usually present in all but the most northern States both winter and summer.

[1] Div. Biol. Surv., U. S. Dept. Agr., 1898, Bull. No. 9, p. 20.

Its name has been given it because of its fondness for cedar-berries, to obtain which it frequents cedar thickets. "These birds are exceedingly hardy and voracious, and for this reason have become adapted to a wide range of food. During the early spring and summer they are said to feed almost exclusively upon insects, and during the last of July and August they feed to a considerable extent upon them. They are dexterous fly-catchers, and when in the woods they labor in a field almost peculiar to themselves. They often station themselves upon the topmost branches of some dead tree-top which commands a view above the forest, and there watch hours together for insects, every few minutes beating off and up into the air to secure the winged forms that are passing above them. On the borders of woods they often fly out six or more rods for passing insects. Besides being fly-catchers they search among the foliage of trees for larvæ of various kinds."[1] Unfortunately, the cedar waxwings are also very fond of cherries, and on this account are in bad repute among fruit-growers. Yet it has been shown that they generally eat only the earliest cherries, and there can be little doubt that during the year they abundantly pay for the fruit taken during the cherry season. In some localities cherry-trees have been so generally planted that there is more than enough for birds and men; in such places the depredations

THE CEDAR-BIRD.

[1] F. H. King.

of these birds are not noticed. Raspberries, elder-berries, myrtle-berries, mulberries, and various other wild fruits are also eaten largely by the cedar-birds.

In the orchard infested by canker-worms treated of in Chapter VI., Professor Forbes shot seven specimens out of a flock of thirty cedar-birds. The stomachs of all these were full of the worms, averaging one hundred to each, so that it was estimated that this flock would destroy ninety thousand of the pests if they stayed in the orchard a month. Among other insects which are known to be eaten by this species may be mentioned beetles, crickets, crane-flies, lace-wing flies, and ichneumon-flies. At the Department of Agriculture the food-contents of one hundred and fifty-two stomachs of this species have been examined, the results showing that seventy-four per cent. of the food consisted of wild fruits, thirteen per cent. of cultivated fruits, only five per cent. of this being cherries. The remaining food consisted of insects,—grasshoppers, bugs, bark-lice, and beetles (among the latter the elm-leaf beetle) being the principal items of the insect bill of fare.

An exceedingly interesting account of the nesting habits of the cedar-bird has been given by Herrick. "The food consisted of choke-cherries and red bird-cherries, varied with raspberries, blackberries, and blueberries, together with insects, which during the last days of life at the nest constituted about one-quarter of the fare." Our own observations show very similar feeding habits. In one case nestling birds were found by another observer to have been fed largely upon the little dung-beetles of the genus Aphodius.

THE SWALLOWS.

Few families of birds are more highly insectivorous than that of the swallows (*Hirundinidæ*). Members of this group have long, pointed wings, small feet, and a short, broad, deeply cleft bill, well adapted to catching insects in the air.

They are migratory, having extraordinary powers of flight, and are almost constantly on the wing. "The habits of swallows," writes Dr. Coues, "best illustrate the modifying influences of civilization on indigenous birds. Formerly they all bred on cliffs, in banks, in hollow trees, and similar places, and many do so still. But most of our species have forsaken these primitive haunts to avail themselves of the convenient

THE BARN-SWALLOW.
(*After Biological Survey.*)

artificial nesting-places that man, intentionally or otherwise, provides. Some are just now in a transition state; thus, the purple martin in settled parts of the country chooses the boxes everywhere provided for its accommodation, while in the West it retains the old custom of breeding in hollow trees." On account of this adaptability to the environments of civilization, swallows should be encouraged as much as pos-

sible by having breeding-places provided in barns and about premises. A little trouble in this direction will be more than repaid by the destruction of injurious insects.

There are seven species of North American swallows, five of which are fairly abundant. Of these the Barn-Swallow is one of the commonest, occurring and breeding throughout most of Canada and the United States. Too many of the new barns are so planned that these birds cannot get inside to build their nests and rear their young, but the wise farmer will leave openings for this purpose. Most of their food is captured on the wing, and consists of small moths, two-winged flies, especially crane-flies, beetles in great variety, flying bugs, and occasionally small dragon-flies. The young are fed with insects.

During "locust years" in Nebraska, Professor Aughey found that these swallows fed very largely on the pests after the latter began to fly: of three specimens shot after the middle of June, two contained thirty-four locusts each and the third one thirty-seven locusts. At such times they appear to feed almost exclusively on locusts, as their stomachs contained very few other insects.

The Cliff-Swallow, or Eaves-Swallow, is irregularly distributed over the United States, breeding abundantly in many localities and being rare in other districts. It flies over upland meadows and pastures, often skimming along near the surface of the ground to catch the numerous leaf-hoppers and other insects found there. A single specimen shot by Professor King while the bird was skimming over a wheat-field contained twelve leaf-hoppers, seven two-winged flies, including one large crane-fly, six small beetles, and two medium-sized ichneumon-flies. It has been reported to catch numbers of small grasshoppers; and six specimens taken in Nebraska after the western locusts had begun to fly had eaten two hundred and twenty-nine of these insects,—an average of thirty-eight to each bird. Five specimens studied by Pro-

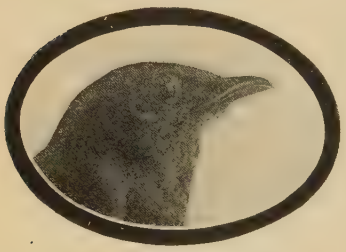
fessor Forbes had eaten ants, wasps, ichneumon-flies, ground-beetles, fungus-beetles, curculios, leaf-beetles, two-winged flies, and certain bugs. The benefits derived from this bird appear to be much greater than any injury it may do in eating parasitic insects.

The White-bellied Swallow appears to be less generally abundant than the last-named species. It is found throughout temperate North America, migrating early in autumn to the Southern States and beyond. Its nest is built in holes in dead stumps, especially those standing in shallow water, although in some localities the birds are taking to martin-boxes for the purpose. The food consists of dragon-flies, the smaller species of which these birds feed upon to a considerable extent, crane-flies and other Diptera, winged plant-lice, grasshoppers, weevils, click-beetles, rove-beetles, and various other Coleoptera, winged ants, ichneumon-flies, and many other insects. In autumn, just before leaving for the South, these and other swallows feed largely on the fruit of the bayberry or waxberry (*Myrica cerifera*). The fact that many dragon-flies are eaten by this bird apparently indicates that it is not an unmixed blessing, but in our present ignorance of the precise economic status of these insects comparatively little weight can be given to this circumstance.

The Bank-Swallow is the most widely distributed American member of its family. Besides America it occurs in Europe, Asia, and Africa. It breeds abundantly in holes made in natural or artificial embankments, and, unfortunately, suffers largely in many parts of the United States from the budding scientists of juvenile age who rob birds' nests for the sake of the eggs. The young are fed on grasshoppers and other insects; the adults are insectivorous, although they often eat the fruit of the bayberry late in summer or early in autumn.

No swallow is more familiar about the haunts of man than the Purple Martin. It is an abundant species and readily nests in boxes provided for the purpose. It is a great insect-

eater, but, unfortunately, it seems to include many beneficial as well as injurious insects on its bill of fare. Apiarists charge it with feeding on bees, although some observers contend that it takes mostly drones. Dr. Packard found one of the compartments of a martin-box "literally packed with the dried remains of the little yellow and black squash-beetle." Professor King found that the stomachs of four eight-days-old nestlings contained, respectively, "(*a*) two butterflies (*Colias philodice* and a skipper), six honey-bees, and many bits of shells of small mollusks; (*b*) two large dragon-flies, a large bee-fly, two honey-bees, and bits of shells of small mollusks; (*c*) one large dragon-fly, three honey-bees, and fragments of the shells of small mollusks; (*d*) two medium-sized dragon-flies, one honey-bee, and small pieces of shells." Another young bird recently from the nest had eaten tiger-beetles. These young birds certainly make a poor showing for the usefulness of the species, but I do not believe that their food fairly represents the food of the birds as a whole. The adults would be much more likely to give their young the larger insects they caught, reserving for themselves the smaller forms. Ten Nebraska specimens examined by Professor Aughey had eaten two hundred and sixty-five locusts and one hundred and sixty-one other insects. "No bird of North America," writes Mr. Ridgeway, "is more deserving of protection and of encouragement to live about the habitations of man than the purple martin. One pair of them will destroy more insects in a season than all the English sparrows in a township will kill in their life-time. Besides, their notes are pleasing to the ear, and their actions, both when on the wing and when perching upon their boxes, are extremely interesting."



HEAD OF PURPLE MARTIN.

THE TANAGERS.

The family of tanagers (*Tanagridæ*), which in tropical America contains many brilliant and beautiful species, has several representatives in the United States, only two of which commonly inhabit the eastern region. All are brightly colored birds, with a stout bill, notched at the tip and having a tooth or lobe near the middle. They are migratory in habits and subsist upon both insects and fruit.

The Scarlet Tanager is the most strikingly colored of any of our birds. The male is of a brilliant scarlet, with deep-black wings and tail; the female is olive-green above, greenish yellow below, with wings and tail more or less dusky. This bird is common throughout the Eastern States, ranging westward a little beyond the Mississippi. It nests in trees in woods and groves, and winters in the South. Its food consists mostly of insects, of which it takes a varied assortment. The stomachs of various specimens have been found to contain ants, ichneumon-flies, including what was thought to be the large *Thalessa lunator*, many caterpillars, crane-flies and other Diptera, curculios, click-beetles, leaf-chafers, and various other beetles, grasshoppers, a few bugs, an occasional dragon-fly or spider, and several harvest-spiders. A single Nebraska specimen shot in the autumn of 1874 contained thirty-seven locusts. Three nestlings less than a week old, examined by Professor King, had eaten four caterpillars, one fly, one small grasshopper, one bug, besides undetermined fragments.

The feeding habits of the Rose Tanager, or Summer Red-Bird, seem to be less known than those of the last-named species. One specimen taken in Maryland had eaten wild blackberries, a bee, and a wasp. Mr. Robert Ridgway says that its food consists to a great extent of hornets, wasps, and bees, because of which it is sometimes called "red bee-bird." It is more southerly in distribution than the scarlet tanager.

CHAPTER XII.

THE FINCHES AND SPARROWS.

The family *Fringillidæ*, to which belong the sparrows, finches, buntings, and grosbeaks, contains more than one-seventh of the species of North American birds. It is even richer in forms than the warblers, although the latter doubtless destroy many more insects than do the former. The finches, as a rule, are birds of moderate size, of sombre colors, and of both vegetivorous and insectivorous habits. The majority of them subsist upon seeds and grains of various kinds; but some eat other vegetation, including buds and fruit, and many feed to a large extent upon insects. They are more or less migratory, and some of them usually go in small flocks. They are found in all sorts of situations. Many of the species are excellent singers.

Of the true grosbeaks occurring in our fauna, the Evening Grosbeak is a western form that occasionally migrates in winter to the region of the great lakes and even farther east. It feeds upon the seeds and buds of various trees, such as the pine, poplar, spruce, maple, black ash, and cotton-wood, and has been found sometimes to include grasshoppers in its bill of fare.

The Pine Grosbeak is a northern form which in winter ranges southward through the New England and other Northern States. The birds travel in small flocks, which spend much of their time in coniferous forests, feeding upon buds of pine and spruce; they also eat the buds and seeds of white ash, basswood, alder, birch, apple, pear, and poplar, as well as the berries of the red cedar and the high-bush cranberry. In winter they often subsist largely upon the pulp and seeds of frozen apples. In some instances they

have been known to injure fruit orchards by feeding upon the buds, but this is a rare occurrence. Professor Aughey found that five Nebraska specimens taken during winter had eaten, along with various seeds, a large number of eggs of the Rocky Mountain locust. The pine grosbeak is one of the largest species of this family in the more northern States.

The Purple Finch is a handsome and somewhat familiar bird, found throughout nearly all of the United States. It is migratory and usually goes in flocks, except during the breeding season. In the Northern States its nest of vegetable fibre is frequently placed on trees near houses. Unfortunately, the feeding habits of this species are not all that could be desired. Many years ago an eminent ornithologist wrote concerning the purple finch: "This is a winter bird of passage, coming to us in large flocks from the North in September and October; great numbers remaining with us in Pennsylvania during the whole winter, feeding on the seeds of the poplar, button-wood, juniper, cedar, and on those of many rank weeds that flourish in rich bottoms and along the margins of creeks. When the rainy season is very severe, they proceed to the South, as far at least as Georgia, returning north early in April. They now frequent the elm-trees, feeding on the slender but sweet covering of the flowers; and as soon as the cherries put out their blossoms they feed almost exclusively upon the stamens of the flowers; afterwards the apple-blossoms are attacked in the same manner; and their depredations on these continue until they disappear, which is usually about the tenth or middle of May." Many later observers have seen the purple finch eating the tender portions of the buds and blossoms of apple, cherry, plum, and peach, although little real damage seems to be done by it, and, as a partial offset, it is also known to devour aphides and various caterpillars.

The beautiful little American Goldfinch, or Thistle-Bird, is familiar to all residents of temperate North America who

pay the slightest attention to feathered beauty. Except during the breeding season these birds wander about in small flocks, stopping wherever a supply of seeds extends an invitation. They are especially fond of the seeds of composite plants, like the thistle, dandelion, and sunflower, and in winter frequently dine upon the balls of the button-bush, although they more commonly eat the seeds of ragweed and various other noxious plants. At this season also they get much of their food from the seeds of birch and similar trees. They occasionally attack seed intended by man for other purposes, but the benefits we derive from them more than compensate for the injury so done. They also take a few insects, having been reported to devour plant-lice, the Hessian fly, and the Rocky Mountain locust. The downy nest is built very late in the season, generally in July, and from four to six young are reared, the latter being fed largely upon the seeds of thistles.

AMERICAN GOLDFINCH.

The Snow-Bird, or Snow-Bunting, is one of the most beneficial of the seed-eaters. It breeds in the summer in the Arctic regions, and in winter visits the Northern States in large flocks. It commonly frequents cultivated fields, where there is an abundance of seeds of weedy plants, like the fox-tail grass (*Setaria*) and bindweed (*Convolvulus*). The snow-birds keep close to the ground, seldom staying in trees, and are welcome visitors, adding much to the scanty life of our winter landscapes.

The lovely little bird celebrated by John Burroughs as the Vesper-Sparrow, and known also as the Grass-Finch, or Bay-winged Bunting, is one of the most abundant of the

sparrows, and can readily be distinguished from its relatives by the white lateral tail-feathers shown when it flies. It is widely distributed and partially migratory. It frequents grass-lands and cultivated fields, in the Western States often making its nest in corn-fields. Two or three broods are reared each season, with from four to six young in each brood. The food of a number of New Hampshire nestlings consisted of spiders and larvæ of various kinds. The diet of thirty-seven Wisconsin adults was studied by King: of these "thirty-one had eaten various small weed seeds; five, four grasshoppers; one, eight grasshoppers' eggs; four, ten larvæ; fourteen, twenty-seven small beetles; three, eight moths; one, three flies; one, three land-snails; one, two kernels of wheat; and one, a kernel of rye."

The examination of one hundred and thirty stomachs of this species at the United States Department of Agriculture showed that two-thirds of the food of the year is of vegetable matter, the rest being largely insects and spiders. In winter the food consists chiefly of the seeds of weedy plants, especially ragweed, amaranth, lamb's-quarters, and purslane. In summer the birds eat chiefly insects, especially grasshoppers, beetles, cutworms, army-worms, and other sorts. In July grasshoppers form nearly half the sparrows' food.

The Tree-Sparrow, which comes down from the far North, usually towards the end of October and remains with us until April, not only serves to enliven winter, but at the same time does much good by destroying great quantities of weed seed. The good work laid down by the chipping, field, vesper, savanna, and the other sparrows, less hardy than this boreal species, is quickly taken up and continued until their return. In New Hampshire the date of the chipping-sparrow's departure is almost precisely that of the tree-sparrow's arrival, and *vice versa.*

In the Northern States, except along the coast, the snow is so deep that but few seeds eaten by this sparrow are left

uncovered, and for that reason comparatively few birds remain there during the hardest part of the winter. A little farther south they are very abundant in cold weather, and the amount of seed they consume is wellnigh incredible.

Professor Beal[1] has estimated that during the two hundred days they average to remain in the State of Iowa, reckoning ten sparrows to the square mile and one-fourth of an ounce as the daily ration, eight hundred and seventy-five tons of weed seed are eaten by this species alone. The only complaint to be entered against it is that sometimes it eats the seeds of cultivated millet left exposed in shocks out-of-doors.

The White-crowned and the White-throated Sparrows have much the same feeding habits as the tree-sparrow. The seeds of ragweed and the various sorts of smartweed, knotweed, and bindweed form a chief part of their winter food. About three-fourths of the food of both species consists of vegetable matter, the rest being insects and allied forms. These two species differ from most of the other sparrows in that they take very few grasshoppers and comparatively little grass-seed, while on the other hand they take a small percentage of wild fruit.

The Pacific coast form of the white-crowned sparrow—sometimes called Nuttall's sparrow—has been carefully studied by Dr. T. S. Palmer. Unlike most of the native sparrows, this subspecies is sometimes injurious through its destruction of grain in newly sown fields or that ready to harvest. As a partial compensation, however, these birds eat great quantities of weed seeds.

The Field-Sparrow is an abundant and widely distributed species, occurring in summer in southern Canada and the Northern States and in winter in the Southern States. Its food is approximately forty per cent. animal and sixty per

[1] See Some Common Birds in their Relation to Agriculture, p. 28.

cent. vegetable matter. Insects and the seeds of weeds and grasses are eaten in a way very similar to that of the other ground-loving sparrows.

THE FIELD-SPARROW.
(*After Biological Survey.*)

The sombre-colored SAVANNA-SPARROW, either in the typical form or in that of the closely related species and subspecies, is found throughout almost all of North America. It is a ground-loving bird, and abounds in meadows and pastures and along highways, as well as by the margins of brooks and in stubble or corn-fields. It feeds upon the seeds of weeds and grasses, and also upon such insects as beetles, moths, and caterpillars, animal and vegetable matter being about equally divided. It has a special liking for beetles. Its nest is placed in a clump of grass and carefully concealed from view.

The common CHIPPING-SPARROW, or HAIR-BIRD, is the most familiar of the sparrows, living freely about houses and in gardens. It is abundant and widely distributed, and an unassuming but extremely useful little bird, which probably

suffers more from the attacks of cats than does any other species. The neat hair-lined nest is placed in a shrub or tree, often near a house. Its food consists of insects and small seeds: of the former smooth caterpillars, like cutworms and canker-worms, are favorites, but beetles, grasshoppers, moths, ants, and bugs are also eaten. It has been observed feeding upon the common cabbage-worm (*Pieris rapæ*).

Dr. Judd's studies of two hundred and fifty stomachs of the chipping-sparrow show that insects and spiders form thirty-eight per cent. of the food of the adults, the remainder being seeds. The seeds of grasses alone form forty-eight per cent., more than half of it being crab-grass and pigeon-grass. In our study of the feeding of the nestlings of this species we saw the parent birds come to the nest almost two hundred times in one day from daylight to dark. The young are fed with smooth caterpillars of various sorts, as well as grasshoppers, crane-flies, spiders, and similar creatures.

The Junco, or Black Snow-Bird, is a common winter resident or migrant in most of the United States, breeding in the northern tier of States and in Canada. Its principal food consists of the seeds of weeds and grasses, although in summer a good many insects are eaten, these forming about one-half of its summer diet.

No bird is a more welcome harbinger of spring than the Song-Sparrow. When one hears its cheery song on a bright March morning, he knows that the frost king is vanquished and will soon retreat before the living armies that usher gentle spring to the front. This bird is indeed "a hearty, sunny songster, whose quivering pipe is often tuned to the most dreary scenes." The typical form inhabits the United States and Canada, while the western region has several closely allied subspecies. It abounds in shrubbery everywhere, along road-sides, fences, brooks, and swamps. It winters in the Middle States and southward, some specimens migrating north very early in spring, into those States

where they have not passed the winter. Its nest is placed on the ground or in a low bush, and two or three broods are reared each season. "It seeks its food on the ground, generally among bushes or weeds, and has a peculiar mouse-like way of running through the grass." During the winter it lives mostly on the seeds of weeds, while in summer it is largely insectivorous. In spring it feeds upon the seeds of dandelion. When canker-worms are abundant it feeds freely upon them, and at other times takes a great variety of insects, such as ground-beetles, grasshoppers and their eggs, occasionally a lady-bird beetle and various noxious beetles, moths, dragon-flies, crickets, spiders, bugs, two-winged flies, and myriapods.

THE SONG-SPARROW.
(*After Biological Survey.*)

Considering its abundance, comparatively few people are familiar with the song or appearance of the Swamp-Sparrow. This bird is a recluse, living in the tangled shrubbery of lowland swamps, where he may often be seen by the nature-lover who will patiently penetrate to his retreat. This species breeds commonly in New England, rearing two or three broods each summer, and spends the winter in the South. Insects appear to form about half its food: among those taken from the stomachs of this species we may mention beetles, moths, bugs (including plant-lice and leaf-hoppers), grasshoppers, caterpillars (among them case-bearers of the genus Coleophora), and a few parasitic Hymenoptera. They also eat snails and the seeds of various grasses, sedges, and

other weedy plants, the latter forming fully one-half of their food. The army-worm is perhaps the most destructive insect which the swamp-sparrow is likely to assist in checking, because the insect develops especially in the marsh lands where the birds live.

"The Dickcissel," writes Dr. Judd, in his admirable monograph,[1] "formerly raised its broods over a considerable portion

THE DICKCISSEL.
(*After Biological Survey.*)

of the United States east of the Rocky Mountains; but two or three decades ago it abandoned the Eastern States and now rarely breeds east of the Allegheny Mountains. In autumn it migrates to Central and South America. In some localities it is known as the little meadow-lark, because its coloring is like that of the meadow-lark, even to the black locket on the

[1] The Relation of Sparrows to Agriculture, Bull. No. 15, U. S. Biological Survey.

breast of brilliant yellow. Most sparrows are gregarious, but dickcissels move about in pairs or little family groups. In many places they are so numerous that a score of individuals may be found in every hay-field and meadow; and the species is as characteristic of such localities as the robin is of the New England lawn, or the mocking-bird of the Florida plantation. The song consists of a series of monotonous insect notes, repeated incessantly from early morn to late afternoon, resembling somewhat the heat-suggestive tones of the grasshopper."

The food of the dickcissel is especially noteworthy on account of the grasshoppers and crickets eaten: in summer these constitute more than half its dietary. The vegetable food consists of the seeds of weeds and grasses.

In the shrubbery along the borders of woodlands one may often see a black bird with chestnut sides skulking from bush to bush or scratching the leaf-covered soil. This is the Chewink, or Towhee Bunting, one of the larger finches, which is common in the eastern United States and Canada. It is migratory; its nest is placed upon the ground, and two broods of young are reared each season. Its food consists of small seeds, grains, and fruits, as well as many insects; among the latter are included moths, beetles, ants, wasps, and ichneumon-flies, cockroaches, grasshoppers, walking-sticks and their eggs, besides larvæ of many kinds. The young are fed upon insects similar to those eaten by the adults.

The beautiful Rose-breasted Grosbeak is especially noted for its destruction of Colorado potato-beetles. Observers in Connecticut, New Jersey, New York, Michigan, Illinois, Iowa, Wisconsin, Minnesota, and other States have repeatedly noticed this habit, which in some localities has given the species the name of "potato-bug bird." The following sentences from the pen of Professor F. E. L. Beal illustrate its economic value: "The rose-breasted grosbeak feeds upon the Colorado potato-beetle in all its stages. I observed this habit in central Iowa, and noticed that it became each year more

general, the birds of this species seeking the potato-field more and more each season. I observed one small field near my house that was much infested with the beetles, but the birds found it, and in a few weeks I searched the field and could not discover a single beetle young or old." Of eight stomachs

THE ROSE-BREASTED GROSBEAK.
(*After Biological Survey.*)

of this species examined by King, six contained small seeds, two seven beetles, and one berries, while specimens examined by Forbes had eaten canker-worms, army-worms, and other caterpillars, wood-boring, leaf-chafing, and snout-beetles, as well as Hymenoptera and weed seeds. Two Nebraska specimens examined by Aughey had about a dozen locusts in each stomach.

As a result of the examination of some four thousand stomachs of sparrows of many sorts, collected all over the United States, Dr. S. D. Judd concludes that "during the colder half of the year the food of these birds consists almost entirely of the seeds of weeds." And he records this intensive study of the effect of their work: "On a farm in Maryland, just outside the District of Columbia, tree-sparrows, fox-

sparrows, white-throats, song-sparrows, and juncos fairly swarmed during December in the briers of the ditches between the corn-fields. They came into the open fields to feed upon weed seed, and worked hardest where the smartweed formed a tangle on low ground. Later in the season the place was carefully examined. In one corn-field near a ditch the smartweed formed a thicket over three feet high, and the ground beneath was literally black with seeds. Examination showed that these seeds had been cracked open and the meat removed. In a rectangular space of eighteen square inches were found eleven hundred and thirty half seeds and only two whole seeds. Even as late as May 13 the birds were still feeding on the seeds of these and other weeds in the fields; in fact, out of a collection of sixteen sparrows, twelve, mainly song, chipping, and field sparrows, had been eating old weed seed. A search was made for seeds of various weeds, but so thoroughly had the work been done that only half a dozen seeds could be found. The birds had taken practically all the seed that was not covered; in fact, the song-sparrow and several others scratch up much buried seed."

This summary of the economic relations of the commoner members of the finch family shows that, on the whole, these birds serve a very useful purpose by destroying the seeds of noxious plants and the lives of injurious insects, but that some species, like the purple finch and pine grosbeak, are occasionally destructive to the buds of fruit-trees. The most striking particulars brought out by a study of their diet are the enormous amount of weed seed taken during winter and the extent to which these so-called seed-eaters take insect food in spring and summer, especially in the presence of an unusual abundance of an edible species. For example, in an orchard infested by canker-worms forty-seven members of this family had eaten ninety-one per cent. of insects and only seven per cent. of seeds, canker-worms alone making forty per cent. of the food.

CHAPTER XIII.

THE ENGLISH SPARROW.

The European house-sparrow, familiarly known to Americans as the English sparrow, was first introduced into the United States in 1850, when eight pairs were brought from England to Brooklyn, New York. These did not thrive, and two years later a large lot of the birds were brought to the same city and liberated during the spring of 1853 in Greenwood Cemetery. During the next twenty years extensive importations were made, the birds being brought from England and Germany and liberated in Maine, Rhode Island, Massachusetts, Connecticut, New York, Pennsylvania, Ohio, and Texas. The largest consignment was that received in Philadelphia, when one thousand birds were set free. After the sparrows had become established in these various centres, misguided men assisted their migrations by carrying them to towns and cities in which they were not yet found. Everywhere they were petted and watched over; in some States special laws were enacted to protect them: the people fostered an evil that is not now easily subdued. Even when kindly Nature sent the great northern shrike to check the sparrow's increase on Boston Common, the authorities hired a man to shoot the shrikes and save the sparrows,—a reversal of the wiser process.

The sparrows seem to have been first imported to destroy canker-worms and other insects affecting fruit- and shade-trees. People annoyed by the defoliation of avenues of shade-trees hailed with delight the feathered friends that were to rid them of their crawling foes. The enthusiasm passed from town to town, resulting in a sparrow boom that sent the prices of American-bred birds so high that European

importations were cheaper. Many immigrants from the Old World cherished the birds on account of their associations with the scenes of early life; and native Americans encouraged them because of their supposed insectivorous habits, or from the desire to have birds to enliven city streets and premises. Without stopping to inquire the reasons for the hospitalities they received, the sparrows made the most of their opportunities and throve apace. From the time of their first general introduction to the present, says Professor Barrows, "the marvellous rapidity of the sparrow multiplication, the surprising swiftness of its extension, and the prodigious size of the area it has overspread are without parallel in the history of any bird. Like a noxious weed transplanted to a fertile soil, it has taken root and become disseminated over half a continent before the significance of its presence has come to be understood."

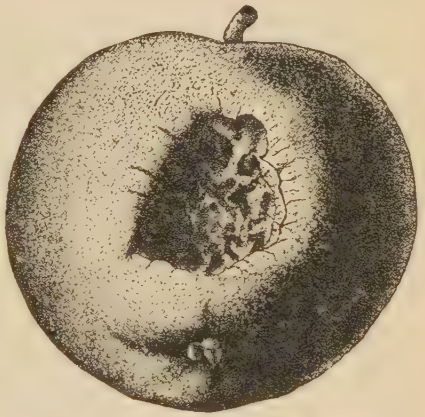
After the little foreigner had been coddled through the trying period of acclimation and had taken possession of the country, the popular mind underwent a revulsion of feeling towards him. He was declared a nuisance because of his noise, reviled as a humbug, and shot for being a poacher. But the sparrow kept on, like a true Anglo-Saxon, in the even tenor of his way. In many places he suffered severely, but he was so thoroughly disseminated and his fecundity was so great that any loss man could inflict was of little consequence to his race. Of late years there is less heard against him than formerly, and it seems as if the people are at last in the mood to make the best of a bad bargain.

As regards food habits of the English sparrow, it is definitely known that the adult birds eat a few insects,—caterpillars, moths, beetles, etc.,—and that the young are fed quite largely on insects. In the country and the suburbs of towns, they may often be seen searching the fields for grasshoppers and other insects, while feeding young, as assiduously as even the chipping-sparrow.

A few years ago the officials of the United States Department of Agriculture examined the stomachs of five hundred and twenty-two sparrows from many different localities: insects of any kind were found in only one hundred and two of these; and of the insects so found forty-seven were regarded as belonging to noxious species, fifty to beneficial species, and thirty-one to species having no economic importance. The testimony of those best able to judge is almost unanimously to the effect that as destroyers of noxious insects the sparrows are worse than useless. In his report upon the insect contents of the five hundred and twenty-two sparrow stomachs just referred to, Dr. C. V. Riley says: "I do not know of any fact that more strongly indicates the relative uselessness in destroying injurious insects of the sparrow, as compared with many native birds which it drives away, than by a comparison of the insect food taken by a single cuckoo shot in Washington, June 22, 1887, the stomach of which contained about two hundred and fifty half-grown web-worms, one large cerambycid beetle and its eggs, one large plant-bug, and one snail, while in bulk the contents in this case rather exceeded the combined insect contents of the five hundred and twenty-two sparrow stomachs examined." In 1880 Professor S. A. Forbes examined the stomachs of twenty-five Illinois sparrows, and reports that at a "time when thirty per cent. of the food of the robin, twenty per cent. of that of the cat-bird, and ninety per cent. of that of the bluebird consisted of insects, no insects were found in the stomachs of these birds except traces of three grasshoppers, making perhaps six per cent. of the food." To show that results of this kind in investigating the sparrow's diet are not confined to America, we may add that of an English ornithologist who studied during a whole year the food of young and adult sparrows. For the latter he found that seventy-five per cent. of the food consisted of wheat and small grains, ten per cent. of seeds of weeds, four per cent. of green peas, three per

cent. of beetles, two per cent. of caterpillars, one per cent. of flying insects, and five per cent. of other things. During the first sixteen days of the nestlings' life, forty per cent. of the food consisted of small grains, forty per cent. of caterpillars, and ten per cent. of small beetles.

If the sparrow had no greater sin to answer for than that of not destroying a sufficient number of injurious insects, he might be left in peace. But he is charged with a long list of sins of commission that are not so easily condoned. Observations frequently repeated in widely separated localities have established beyond doubt the fact that he habitually destroys, either for food or pleasure, the buds and blossoms of a great variety of fruit, shade, and ornamental trees. On the list of trees and shrubs so attacked we find the peach, pear, grape, plum, cherry, apple, currant, maple, elm, evergreens, orange, lilac, and others. This injury is accomplished in spring and often results in the total destruction of the fruit crop. Not content, however, with nipping the fruits in the bud, the sparrows continue their attacks later when the fruits are maturing: among the ripe or ripening fruits they so attack we may mention grapes, cherries, blackberries, strawberries, raspberries, apples, pears, peaches, plums, tomatoes, and currants. The injury to grapes is occasionally quite severe, and that to early apples is particularly vexatious, as they peck holes, similar to that shown in the figure above, in the ripening fruit. Garden



APPLE PECKED BY ENGLISH SPARROWS.
(*After Biological Survey.*)

vegetables are often attacked, green peas being especially liable to injury. In many localities it has become very difficult to get a crop of peas, on account of the sparrows, which destroy the blossoms at first and later attack the pods. Green corn, lettuce, cabbage, and other vegetables are also attacked, and not infrequently the newly planted seeds are scratched to the surface and devoured.

The list of the sparrow's sins of commission is by no means ended. In attacking grain of various kinds these birds probably cause more loss than in all the ways mentioned above. From the time small grains, like wheat and oats, are planted until safely gathered in the bin, they are liable to suffer from sparrow attack. The greatest damage is probably done when the grain is in the soft condition which immediately precedes ripening, but it also suffers greatly at the time of planting and in the "shock" just after harvesting. Besides the grains already mentioned these birds attack Indian corn, rye, barley, sorghum, rice, and buckwheat.

These charges against the sparrow's food habits are grave indeed. There is something to be said in his favor, however. Mr. Charles W. Nash[1] states that "Sparrows, like the majority of birds, will not often eat the spiny larvæ of *Vanessa antiopa*, which is one of our shade-tree pests that few birds will touch. Besides this I have seen them take moths of almost any kind, including the large cecropia and luna moths and the tussock moth (both the winged male and the wingless female), beetles of many kinds, even such large species as the *Dytiscus*, which they find on the sidewalks beneath the electric lights, to which the beetles are attracted at night, the green cabbage-worm (the larva of the cabbage-butterfly)—of these they eat great numbers. They also hunt about fences and take the pupæ of this same butterfly. The currant-worms and mature

[1] See "The Birds of Ontario in relation to Agriculture," second edition, p. 68, published by the Ontario Department of Agriculture.

insects are taken in large numbers, as are also grasshoppers, and both the black and green aphides that occur on apple-trees and rose-bushes are eaten greedily. On one occasion a flock of sparrows completely cleaned the green aphis from some rose-bushes near my windows. It took them several days to finish their work, but they did it effectually in the end."

Of the food eaten by nestlings[1] more than half consists of insects. In his account of the food of nestling birds Dr. Judd, of the Department of Agriculture, has the following to say of the English sparrow.

"From April till August weevils and cutworms are taken to the young from the Department lawns. Some interesting observations on the insectivorous habits of young English sparrows by Mr. George H. Berry, of North Livermore, Maine, are worth repeating in this connection.[2] In a nest containing three young he discovered the remains of two large moths, the luna moth (*Tropæa luna*) and the cecropia moth (*Samia cecropia*), a swallow-tailed butterfly (*Papilio turnus*), a mourning-cloak butterfly (*Vanessa antiopa*), and an unbroken specimen of the hairy larva of that pest of shade-trees, the tussock moth (*Orgyia leucostigma*). When he placed a stick with plenty of these larvæ near another brood, the parent birds at first paid no attention to them, but subsequently they fed three of them to their young. During three hours of observation a pair of sparrows noted by Mr. Berry fed to their nestlings sixty small green worms. Multitudes of insects may be destroyed in this way. One morning, in the vicinity of the Department of Agriculture, thousands of winged white ants (*Termes flavipes*) were noticed by the writer swarming over the sidewalk, and among these insects, picking them up with surprising quickness, were half a dozen adult English spar-

[1] See 1900 Yearbook, Dept. Agr., p. 421.

[2] Bulletin 1, Div. Ornith. and Mamm., Dept. Agr., p. 291, 1889.

rows of both sexes. All the birds were frightened away except one female, which continued to snap up ants undisturbedly. She flew with a dozen up to her nest in the gutter of a house, and immediately returned. At the end of five minutes she had made three more trips, carrying to the young forty-one, seventy-one, and fifty in the respective trips; one hundred and sixty-two white ants were thus disposed of in five minutes. The systematic manner in which the bird procured her supplies commanded admiration. She picked up insect after insect in rapid succession, swallowed them until her gullet appeared to be full, and then filled her mouth so that a fringe of wings stuck out on each side of her bill. The destruction of white ants is a service, as they have a habit of tunnelling into the wood-work of buildings. Injuries occasioned in this way made it necessary in 1896 to remove the wooden floor of one of the largest rooms of the United States National Museum and replace it with cement."

More than one-third of the food of the nestlings, however, has been found to consist of grain.

By large numbers of city people the sparrows are considered an unmitigated nuisance on account of the filth they cause. Wherever they appear abundantly, all available places about houses and buildings are chosen either for purposes of roosting or nesting. The excrement of the birds soils everything beneath and is a constant source of annoyance. When they roost among or over climbing vines, the foliage is often killed outright by the droppings.

There yet remains another count in the indictment against the sparrow, which many nature-lovers consider the most serious of all. We refer to its influence upon native song-birds. Nearly all competent observers agree that this influence is very baneful. The sparrows drive the native birds away from their nesting-places and molest them upon all sorts of occasions. The bluebirds, martins, swallows, native spar-

rows, orioles, vireos, the mocking-bird, and scores of others are on the list of those thus molested.

As an example of one of the ways in which these sparrows harass our native birds, we quote the following letter, published in the excellent "Listener" column of the Boston *Transcript.*

"Dear Listener,—I have been advised by friends interested in the English sparrow problem to send you an account of what I myself saw, and what was at the same time seen by several others called by me as witnesses.

"Near my school-house (the Washington), within the grounds of Dr. John W. Driver, Brattle Street, is an American elm whose branches extend far out over the street. It has been a favorite nesting-place for the Baltimore oriole for several consecutive years, so that we have become accustomed to watching not only the most interesting process of nest-building, but also the care and labor given to the feeding and rearing of their young.

"On or near the 20th of June my attention was fixed upon the nest by seeing an English sparrow alight upon it. In a few moments the mother bird returned with food for her little ones, who greeted her with their accustomed cries of welcome. Instantly upon alighting she was seized by the sparrow, both of whom went fluttering to the ground, contact with which broke the sparrow's grip. For a moment both remained facing each other, the oriole trembling as if in great fear. Then, to my surprise, the oriole flew in search of food, while the sparrow flew directly to the nest again, to await the return of the mother oriole. It waited but a brief time, when there occurred a repetition of the fluttering to the ground. This we observed, with others, for as many as six times, when our duties called us from the scene.

"Noticing the nest in the autumn, and believing that here had taken place another 'bird tragedy,' we secured the nest,

only to have our worst fears fully realized. It contained the skeletons of two or more baby orioles!

"J. W. FREESE.

"17 Chauncy Street, Cambridge, Mass., Oct. 3."

In certain States an attempt has been made to check the increase of sparrows by means of bounties. But these are nearly always worse than useless, as they bring about the destruction of large numbers of native birds, and theoretical considerations lead strongly to the conclusion that unless enormous sums are expended for bounties very little permanent good is accomplished.

There have been cases, however, where, under proper direction, a town has been kept fairly clear of these birds. The following quotation from a letter received by the writers from Mr. Rufus Kendrick, of Wakefield, Massachusetts, details a plan that worked. After recounting instances in which he had known the sparrows to interfere with nests of native birds near his home, he went on to say: "I had cared for a sparrow's nest as well as for the others, as I did not at that time know the destructive qualities of the bird. Soon after, I learned of other cases. Then I began my crusade. The town, learning of their depredations, favored me with fifty dollars. This, with many private contributions and another fifty dollars from the town, is what I had to work with. I began by paying one cent each for them, then, as they grew scarce, I paid two, three, four, and five cents each for them. I also paid one dollar per hundred for the eggs. The price now is two cents for birds and one cent each for eggs. At one time I had about fifty men and boys killing them. I took in over one thousand the first year. This year, January 1, I paid premiums amounting to two dollars and a half for once in three months. To the party bringing me the largest number of birds in three months I paid one dollar, for the second largest number seventy-five cents, for the third fifty cents,

and the fourth twenty-five cents, making ten dollars in premiums a year. These are paid in addition to the regular price. The native birds have increased noticeably since the crusade began."

Another notable example is that of Cheyenne, Wyoming, recorded in Lange's "Our Native Birds." Mr. Frank Bond, editor of the *Wyoming Tribune*, largely exterminates the sparrows from the city by the use of poisoned wheat. He reports his method as follows:

"I take two small bottles of strychnine, one dram each, and mix the contents with about three quarts of water, boiling until the poison is thoroughly dissolved, using boiling water to begin with. Into the hot poisoned water I stir nearly, if not quite, a peck of wheat, and then set the mixture aside for forty-eight hours. The grain absorbs all the water and swells greatly. I then spread the grain over the bottom of a large pan, one that will just slide into my wife's kitchen range, keep the grain hot and stir it frequently until it is thoroughly dried. The grain must not be scorched in the least, as then the birds, especially the old ones, will not eat it. When the grain is thoroughly dried, it takes a better expert than even an English sparrow to discover any change in its appearance. If an exceedingly deadly grain is wanted, another dram of the poison can be used, but the above will be found effective. It needs but one grain of this wheat to kill a sparrow in three minutes, as I have timed the experiment, and the grain gets no farther than the crop and sometimes not so far. I scatter the grain sparingly near the roosting places of the birds and in localities where they are accustomed to feed. Snowy, cold weather, when there is little bare ground, is the best time. The baited places should be visited daily, if possible, and the dead birds should be removed. You will be surprised at the killings you will make. By persistent effort, you can enormously reduce their numbers, and that is worth working for."

According to Professor Barrows, "Large numbers of the sparrows may be destroyed and their increase prevented by the systematic destruction of their nests, eggs, and young. By the aid of an iron rod and hook set in the end of a long pole, most of their nests can be reached and brought down. This method promises most satisfactory results. They may be easily driven from their roosting places by disturbing them on several successive nights. A very efficacious method is to throw water upon them when at roost. In cities where hose-pipe is available, the process is simple and certain. They may be kept out of ornamental vines in the same manner, particularly in the breeding season, when a thorough soaking not only disconcerts the old birds and kills their young, but at the same time does much good by soaking the vines and washing out their filth. If a part of the birds are shot or caught each time they are disturbed at their roosts, the remainder are much less likely to return."

Mrs. Mary Treat has recorded an ingenious experiment in discouraging the English sparrows on her premises. "A few years ago," she writes, "they were here in great numbers, driving bluebirds and wrens and martins from their boxes. At last I had boxes made on purpose for the plagues, with a hinged cover, and allowed each occupant to lay the requisite number of eggs, usually six, and commence to incubate, when I would destroy the eggs without disturbing the nest. At first the little simpletons, after making a great ado, would in a few days thereafter again lay eggs in the same boxes. Sometimes over thirty eggs were laid in one box. But even the English sparrow finally learns prudence. Each year they appeared in diminished numbers, and last year only one pair attempted to pre-empt a box and they left after the first setting of eggs was destroyed, and the bluebirds and wrens had peace."

A systematic war upon the sparrows, however, is likely to prove troublesome to the authorities having it in charge, on account of the sentiment of those who are not fully informed

upon the subject. A case in point was the campaign in Boston about three years ago, when the park commissioners destroyed the nests by the thousand, the result being such a commotion in the public prints as has rarely been witnessed in connection with any natural history event. Besides the hundreds of columns of letters, advertisements like this appeared in the papers: "Friends of the sparrows, who are willing to have their names used in a remonstrance against their proposed destruction, are requested to send their names and addresses to the Massachusetts Society for the Prevention of Cruelty to Animals, 19 Milk Street, Boston." The society which inserted this advertisement asked permission to erect bird-houses for the sparrows in the public parks. The commissioners finally gave up their efforts, although no greater evidence of the practical uselessness of the sparrows could be asked than the fact that in the very parks in which they were living so abundantly the tussock caterpillars were numerous upon the elm-trees.

CHAPTER XIV.

THE ORIOLES, BLACKBIRDS, CROWS, AND JAYS.

Next to the scarlet tanager the Baltimore Oriole is the most brilliant of our northern birds. It seems a messenger from the tropics when it arrives in May, flashing from grove to orchard in its bright-hued suit and filling the air with the rich melody of its song: this impression is strengthened later when it builds its pendent nest, so different in architecture from that of any of the rest of our birds. It chooses to live

THE BALTIMORE ORIOLE.
(*After Biological Survey.*)

in orchards or groves near the abode of man; it is strictly migratory and is found throughout most of the States east of the Rocky Mountains. From the point of view of the economist it sometimes commits depredations on the pea-pods in the garden, the cherries in the orchard, and the grapes in the vineyard; but these attacks are rare and are more than paid

for by the destruction of noxious insects. Its services in the latter direction are especially helpful because it feeds freely upon tent caterpillars and other hairy larvæ that very few birds will touch. Even the spiny caterpillars of the Vanessa butterfly are taken by it. Three of these orioles shot in an Illinois orchard infested by canker-worms had eaten forty per cent. of these pests and fifty per cent. of an injurious leaf-chafer (*Anomala binotata*). Professor Aughey found that in Nebraska the nestlings were fed freely with young Rocky Mountain locusts, of which also the old birds ate large numbers. In Massachusetts these birds have been observed feeding their nestlings with canker-worms. Professor Beal states that caterpillars alone formed thirty-four per cent. of the food of one hundred and thirteen specimens examined, while vegetable matter of any sort had been eaten only to the extent of sixteen per cent. In Arkansas these orioles have been found to destroy great numbers of the catalpa sphinx larvæ, which when unmolested defoliate the catalpa-trees. This species is called the golden robin in some regions.

"I was sitting at the window one day in May," wrote Wilson Flagg many years ago, "when my sister called my attention to a golden robin in a black-cherry tree, devouring the common hairy caterpillars; and we counted the number he consumed while he remained on the branch. The time that elapsed was just one minute by the watch, and during this space he destroyed seventeen caterpillars. But it is worthy of notice that he did not swallow the whole insect. After seizing it in his bill, he carefully set his foot upon it, tore it asunder, and swallowed a small portion taken from the inside. He then seized others in succession, and in like manner selected and devoured his favorite morsel. Had he consumed the whole caterpillar five or six only would probably have satisfied his appetite." [1]

[1] Agriculture of Massachusetts, 1861, part II. p. 52.

From the Rocky Mountains eastward the Crow Blackbird, either in the form of the Purple Grackle or the Bronzed Grackle, is well known, in the North as a summer visitor and in the Central and Southern States as a resident. Occasionally a few winter in the realm of snow, and there is one record where one bird even stayed in New Hampshire till well into January. In New England they are only locally distributed, usually selecting homes in or near villages. Elsewhere in their range they are much better known. Like

THE CROW BLACKBIRD.
(*After Biological Survey.*)

others of their tribe, they are accused of various misdeeds: the eating of grain is the worst of these. Throughout the year more or less grain is taken, though in summer insects receive the major part of their attention. All sorts of grain as well as wild and cultivated fruits and many kinds of seeds are eaten.

Of the grains, Indian corn is taken in greatest amount. It has been shown, by the examination of two thousand two hundred and fifty-eight stomachs at Washington, that corn is

consumed every month in the year, and that it forms about half of the vegetable food, or a fourth of the entire consumption,—the animal and vegetable materials being about equal. There was little evidence to show that sprouting corn was pulled up, and it appeared that much of the grain was waste matter picked up after the harvest. The record of the September birds was bad: more than half the food for that month was corn, evidently taken from the ear. In October the ratio was nearly as great.

Among the animal food were found insects, spiders, myriapods, crawfish, earthworms, sowbugs, hair-snakes, snails, fishes, tree-toads, salamanders, lizards, snakes, birds' eggs, and mice. While this is an astonishing variety, everything but insects must be considered exceptional, as out of the forty-eight per cent. of animal food forty-six per cent. consisted of insects. Of these, beetles were consumed in greatest quantities. Scarabæids, adult and larval, come first in point of numbers. As is well known, these beetles either as larvæ or adults are consumers of vegetable matter, and many of them are distinctly noxious. The large white grubs so often unearthed by the plow form a favorite article of food: many stomachs were crammed with them. Snout-beetles, among which were curculios and weevils, were found in great numbers in stomachs taken during summer. Bollworms and army-worms are also eaten by these birds. Grasshoppers were found to be largely eaten also: more than thirty were often found in a single bird. This fact, when coupled with the fact that many 'hoppers and caterpillars are fed to the young, demonstrates that in summer at least the crow blackbird is a good friend in helping to keep down the grasshopper pest. Caterpillars and stink-bugs were often in evidence.

In writing of the food of the young crow blackbirds Dr. S. D. Judd says: "The first meal of the nestlings often consists of plump spiders of soft texture, which suit the delicate embryonic stomach; and these, together with tiny young grasshopper

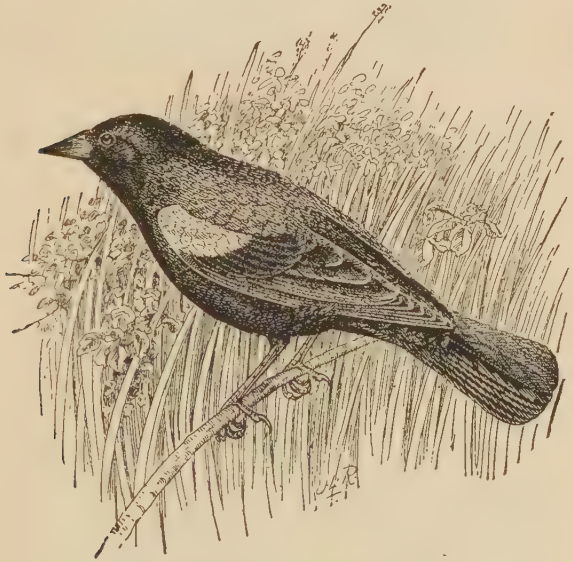
nymphs and soft small cutworms, continue for a while to form the food. As the stomach develops, however, the diet changes; such hard insects as beetles soon become a part of the fare, and by the time the young blackbirds are nearly or quite half grown their stomachs are strong enough to digest corn. Corn is then given to them freely, and in increasing quantity, until, when they are ready to leave the nest, it forms about one-quarter of their food."

Practically all of the insects taken by this species are noxious: if allowed to increase without stint, they would eat us out of house and home. The evidence that many of them are consumed is conclusive. It is also evident that at times blackbirds are an insufferable plague. "As soon as the grain is in the ground," writes Mr. Charles W. Nash, of Toronto, Canada, "they visit the newly sown fields and help themselves liberally, varying their diet by taking as many small birds' eggs and young as they can conveniently get at. I have on several occasions seen them attack and carry off young robins, in spite of the vigorous defence set up by the victims' parents." Looking at the record from both sides there seems but one thing for a sensible man to do,—namely, so long as the bird does well, let him alone; when he becomes pernicious, drive him off or kill him.

In Stanley's "History of Birds" (p. 197) attention is called to the fact that a bounty for the "Purple Grackle or New England Jackdaw" is recorded in King's "Narrative" (vol. ii. p. 217), where it is stated: "A reward of three-pence a dozen was once awarded in that country for the extirpation of the Grackles; and the object was almost affected, at the cost of the inhabitants, who at length discovered that Providence had not formed these supposed destructive birds in vain; for, notwithstanding they caused great havoc among the grain, they made ample recompense by clearing the soil of noxious worms, particularly of one called the pease-beetle. For no sooner were the birds destroyed, than the insects multiplied to such

a degree, as to cause the total loss of the grass in 1749, when the colonists had to get their hay from Pennsylvania and even from Great Britain."

The Red-winged Blackbird is a summer denizen of swamps and marshes throughout temperate North America. It is one of the earliest birds to appear in spring and one of the earliest to leave its breeding-places, though the final departure of the great flocks that congregate in suitable places in August is



THE RED-WINGED BLACKBIRD.
(*After Biological Survey.*)

often delayed till October or November. While feeding their young, red-wings frequently come to the field for grasshoppers and such other insects as are to be found there. At other seasons they are seed-eaters for the most part. Where abundant, they do considerable injury both to newly sown grain and to ripening crops. In some States bounties have been offered for their heads. Their custom of congregating in large flocks makes their evil work very great where it occurs.

Their greatest depredations are committed in the grain-fields of the Mississippi Valley and in the southern rice-fields.

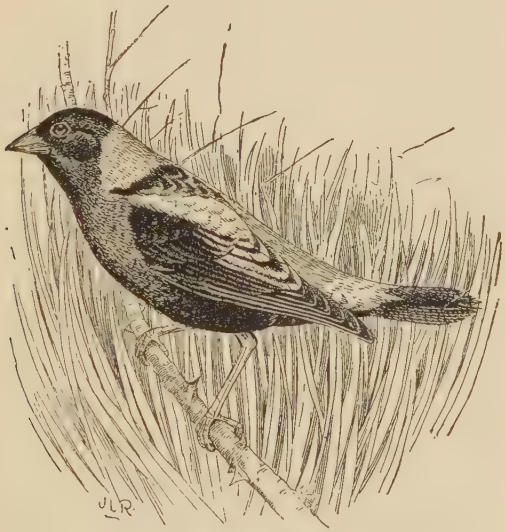
In an examination of seven hundred and twenty-five stomachs the Department of Agriculture found seventy-four per cent. of the food to be vegetable matter, the remainder being animal, mainly insects. Weevils and snout-beetles amounted to twenty-five per cent. of the June food. Beetles formed ten per cent. of the food for the year; grasshoppers formed about five per cent. Of grain only corn, wheat, and oats were found: together they constituted thirteen per cent. of the whole food. Weed seed, mainly ragweed, barn-grass, and smartweed, amounted to fifty-seven per cent. A summary of the food examined reveals the fact that about seven-eighths of the red-wing's diet is made up of noxious insects and weed seed. Therefore, while locally guilty of damage sufficient to justify its slaughter, it would be very poor economy to persecute this bird generally.

The food of the young birds consists almost wholly of insects of the sorts commonly eaten by the adults.

The Cow-Bird is found throughout the United States, except along the Pacific coast. Its name was given in recognition of its fondness for bovine society. It is essentially a bird of the field, spending nearly all its time searching for food in fields and pastures. It eats insects, grasshoppers, beetles, larvæ, etc., in summer, and takes seeds of weeds and occasionally small grains at other seasons to a considerable extent. So far as its food habits are concerned, there is much to commend it, but as a parasite on other birds it is undoubtedly noxious.

Its domestic relations are decidedly irregular. Males are more numerous than females. Polyandry is a common practice. They never pair. They never build nests. By stealth eggs are deposited in other birds' nests, to be hatched and the young raised by foster-parents. Here is where the cow-birds are criminal in effect if not in intention. The cow-bird egg is laid with an uncompleted clutch. It hatches more quickly

than the rightful occupants; it is larger than they, as the hosts are almost invariably smaller than cow-birds,—warblers, vireos, etc. Thus the young cow-bird is able to grow rapidly, and within two or three days is so much ahead of his foster-brothers and -sisters that he gets all the food and they die. It appears to be the rule that a cow-bird's egg laid in a nest ruins the hopes of the birds that built it. Every young cow-bird is reared at the expense of anywhere from two to five other birds, each of which is of more value than he. This makes cow-birds costly. Whatever benefits we derive from their food habits are more than overcome by their parasitic habits.



THE BOBOLINK.
(*After Biological Survey.*)

In the northeast quarter of the United States, it is safe to assert, there is no more popular bird among country folk than the Bobolink. He announces his coming by a shower of melody from the clouds. For a fortnight he revels in bachelor freedom, in glorious apple-blossoms, and pours forth a flood

of song. On the arrival of the females, he quickly makes a match by ardent wooing, and with all the impetuosity of his nature settles down to family cares. No bird is a more devoted parent. Every one on the farm is a witness to his solicitude. The mother bird is perhaps no less anxious for the welfare of her children, but she is more timid. Not alone for sentimental reasons are bobolinks prized by the inhabitants of their summer home-land, for they are highly thought of on account of their destructiveness to insects. During this season they eat insects almost exclusively. To the young they bring grasshoppers. Careful watching at the nest has shown that they discriminate as to color. No less than nine out of every ten 'hoppers brought to the nest are green. There appears to be no choice of species, for long-horned and short-horned 'hoppers were brought in about the same numbers. As a rule, nymphs are preferred to adult specimens. So far as the bobolink's conduct in the North is concerned it is above reproach.

Early in August there is a gathering together of families into flocks, and the movement southward is begun. Then come trying times for "bob" and his enemies. Along the coast of the Middle Atlantic States reed-birds, as they are called there, are slain for the table by untold thousands. Further south they enter the rice-fields when the grain is in the milk, and it is there they cast off virtue and become thieves. The rice-planters have abundant cause for hating them and employ destruction. There is mutual distress. It has been stated that two million dollars' worth of rice is annually destroyed. The number of birds slain is beyond reckoning.

In spite of the enormous drain upon their numbers, the flocks seem as numerous as ever. It is probable, however, that they are actually decreasing. It does not seem possible that the immense numbers annually slain in the South can be made good. Then, in New Hampshire, at least, farmers past

middle age state that bobolinks are not nearly so common in the fields as they were fifty or sixty years ago. While it may be that the rice destroyed is worth more than the slaughter of insects, there is no certainty that it is so, though no one can blame rice-planters for attempting to exterminate the birds. In any case, those who know the bobolink in his northern home can but regard with complaisance the fact that he has a place among things that yet exist.

The MEADOW-LARK, with its "bosom of prairie buttercups, its back like the dead grass of autumn, and its song which

THE MEADOW-LARK.
(*After Biological Survey.*)

harmonizes well with the prairie winds," is essentially a bird of the prairies. But it is not confined to the prairie States: from New England to Florida, from Florida to Mexico, from Mexico to Oregon, and from Oregon back again to New England, where there are open stretches of pasture and meadow lands, one is likely to find the eastern meadow-lark or its western representative. In northern localities it dwells only in summer, migrating southward for the winter, but in many Central States it remains throughout the year. Its nest is built on the ground in a clump of grass and four or five young are reared.

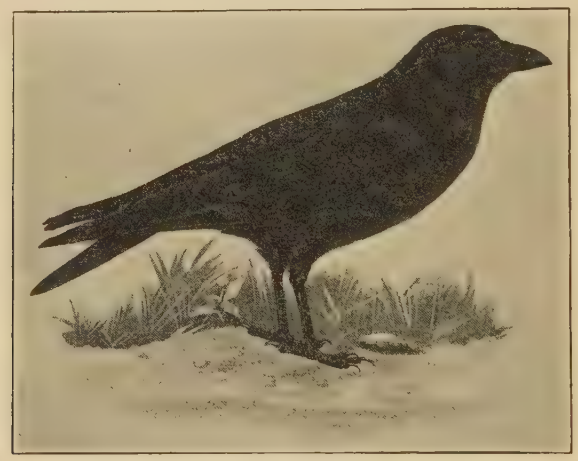
The record of the food of the meadow-lark is unusually full and complete. The stomach contents of ninety-three specimens from seven widely separated States (New York, Pennsylvania, North Carolina, Tennessee, Illinois, Wisconsin, and Nebraska), taken during March, April, May, June, July, August, October, and November, have been examined by competent investigators; the results prove beyond all doubt that this is a bird of extraordinary economic value. Thirty-three specimens from various parts of Illinois, taken during March, April, May, June, and July, were studied by Forbes, who found that three-fourths of the food consisted of insects, the peculiar animals known as "thousand-legs" and grains of corn and wheat constituting the remainder. Caterpillars formed twenty-eight per cent. of the food, one-half of them being cutworms and army-worms and one-fourth the hairy larvæ of the family of "tiger-moths." Even during these early months grasshoppers formed thirteen per cent. of the stomach contents, and beetles of various kinds twenty per cent., one-fourth of them being ground-beetles and the others including June-beetles, blister-beetles, curculios, click-beetles, and plant-beetles. One bird had eaten twenty chinch-bugs, and others had eaten various soldier-bugs. Crane-flies had been occasionally devoured. "Considering these data with reference to the interest of the farm and garden," writes Professor Forbes, "we must admit the probable eminent usefulness of this bird. Its great destruction of grasshoppers and of cutworms and other caterpillars, and the absence of all depredations other than the appropriation of scattered grains of corn (often picked, no doubt, from the droppings of stock), taken in connection with the fact that it eats only the normal average of predaceous insects, are all strong indications of valuable service rendered, with unusually few drawbacks. It supervises our grass-lands much more closely than the bluebird or the robin, and should be carefully protected from the shotgun and birds-nesting school-boy."

Twenty-nine Wisconsin meadow-larks studied by Professor King had eaten forty beetles, including a May-beetle, weevil, tiger-beetle, and ground-beetles; nineteen grasshoppers; many caterpillars; one dragon-fly, and a single thistle-seed. Ninety-nine per cent. of the stomach contents of thirty specimens from various places in New York, Pennsylvania, North Carolina, and Tennessee, shot during October and November and studied by Dr. C. H. Merriam, consisted of insects, including twenty-five caterpillars, fifty-seven grasshoppers, and more than eighty beetles. The seeds of clover, wheat, oats, corn, and various weeds and grasses were also eaten to a slight extent. Eight Nebraska meadow-larks had eaten two hundred and thirteen locusts as well as locusts' eggs and many other insects.

"The farmer cannot afford," writes Dr. S. D. Judd, "to dispense with the services of the meadow-lark, for it busies itself all summer eating grasshoppers and noxious insects, and when autumn comes varies its diet with ragweed, pigeon-grass, and other weeds, until in December these noxious plants comprise twenty-five per cent. of its food."

There has been much discussion concerning the economic status of the Common Crow. By some people its merits are believed to be greater than its defects: by others it is considered an unmitigated nuisance. There seems to be no doubt that, on the whole, the crow is not a bird to be encouraged, although it is not desirable that it be altogether exterminated. It is a widely distributed species, occurring throughout the United States, though much more abundant in some localities than in others. The birds are wary, having learned wisdom from experience, and it is very difficult to get within shooting range of them. The crime that is most commonly laid against them is that of digging or pulling up newly planted grains, such as wheat and Indian corn, especially the latter; in the Eastern States this has led to the almost universal use

of scarecrows of some kind. The damage done in this way is sometimes very great, often causing the loss of one-third of the crop, although, as a rule, the injury is slight. This seems to be an acquired habit, belonging to comparatively few of the crows. One Missouri observer reports that he once saw eight crows in his corn-field, two parents and six young. "One was pulling the corn, one standing idle, and six eating the grain after it was pulled up." Isolated fields and those near the nesting-sites are usually much more liable to



THE COMMON CROW.
(*After Warren.*)

injury than others. Later in the season, when the corn is in the soft, milky stage preceding ripening, the crows again attack it, tearing the husks from the ears and picking out the kernels.

In some parts of New England and Canada the crow is accused of serious injury to recently planted potato fields. When the plants appear above ground the birds pull them up to get at and devour the partially decayed tubers that were used for "seed." In the South rice and pea-nuts are said to

be also attacked, while in various regions injuries to small fruits have been reported.

One of the most serious flaws in the character of the crow is his fondness for eggs and young birds, either in the poultry-yard or out of it. In some localities crows are more dreaded by the poultry-keepers than hawks, as they destroy young chickens before the latter are past the downy stage. The eggs of hens, ducks, and turkeys are also appropriated. Like the corn-pulling habit, this thieving seems to be confined to certain individuals, and it is done chiefly to get food for the nestlings.

That the crow is an inveterate enemy of many of our wild birds there can be no doubt. The evidence in hand conclusively proves that it robs the nests of the commoner thrushes, such as the wood-thrush, brown thrasher, and robin, as well as those of the orioles, blackbirds, sparrows, quail, grouse, woodpeckers, swallows, warblers, and others. Both eggs and young birds are taken. "In all the dark history of the crow's relations to other birds," writes Professor Barrows, "there is nothing which can fairly be called a bright spot, and only here and there a record is found which serves to render the page a little less gloomy. One of the grains of comfort is found in the fact that in its wholesale attacks on other birds a few species suffer which are scarcely better than itself." Any claim to favor which the crows may have is based largely on its insect-eating proclivities. But the definite knowledge as yet obtained goes to show that the crow can scarcely prove itself a philanthropist on this score. While the bird undoubtedly eats large numbers of grasshoppers, the other elements of its insect food are not of great economic importance, consisting as largely of the so-called beneficial species as of the injurious ones. This is shown by the following table, which gives the economic results of a study, made at the Department of Agriculture, of the insect food of sixty-six crows:

Orders.	Species.				Individuals.			
	Beneficial.	Injurious.	Neutral.	Total.	Beneficial.	Injurious.	Neutral.	Total.
Hymenoptera	16	1	0	17	126	8	0	134
Lepidoptera	0	6	0	6	0	16	0	16
Diptera	1	0	0	1	1	0	0	1
Coleoptera	23	16	8	47	85	57	32	174
Hemiptera	1	1	1	3	1	1	1	3
Orthoptera	0	17	0	17	0	150	0	150
Neuroptera	0	0	1	1	0	0	18	18
Total	41	41	10	92	213	232	51	496

A number of observers have reported that the crow kills and eats field-mice and pocket gophers. Others claim that it is useful as a scavenger, feeding on carrion. It is also known to feed largely on various wild berries, such as those of the Virginia creeper, dogwood, bayberry, red cedar, elder, wintergreen, pokeweed, smilax, poison-ivy, and poison-sumach. It scatters the seeds of these plants far and wide, and the fact of its thus aiding in the distribution of poison-ivy and poison-sumach has been considered one point against the bird.

Professor Barrows has summarized the evidence for and against the crow as follows: "(1) Crows seriously damage the corn crop, and injure other grain crops, usually to a less extent. (2) They damage other farm crops to some extent, frequently doing much mischief. (3) They are very destructive to the eggs and young of domesticated fowls. (4) They do incalculable damage to the eggs and young of native birds. (5) They do much harm by the distribution of seeds of poison-ivy, poison-sumach, and perhaps other noxious plants. (6) They do much harm by the destruction of beneficial insects. On the other hand, (1) They do much good by the destruction of injurious insects. (2) They are largely

beneficial through their destruction of mice and other rodents. (3) They are valuable occasionally as scavengers."

The Magpie, ranging from Arizona to Alaska and from the Rocky Mountains to the coast, except a part of California in which it is replaced by the yellow-billed variety known as Nuttall's magpie, although of handsome appearance, has some traits that are utterly disreputable and scarcely one that may be called valuable. He is a thief, stealing the hunter's game, the traveller's supplies, even his very dinner before him. Worse than all, he is an assassin, a torturer without a heart, merciless. Young birds are tidbits for him. With boundless audacity he assaults horses and mules, galled by their harnesses and reduced by continuous packing over rough trails, lacerating their raw flesh and sometimes even going so far as to put out their eyes. If people will have cage-birds, here is a proper victim. A criminal by nature, he may be confined without compunction. His odd and knowing ways make him an interesting pet, and after once becoming accustomed to a cage, captivity does not appear a hardship for him. Economically the magpie is a failure.

The Blue-Jay is a resident over the whole of the United States east of the Great Plains. Its home is in the woods, though it makes frequent excursions to orchards and ornamental trees about the farmstead. These birds are seen to best advantage among the nut trees in autumn. Then is the time of their harvest. From tree to tree they go in troops, calling in glee, swishing the branches, rattling down nuts, forcing an opening by well-directed blows of their powerful bills through hard shells, or busily engaged in hoarding supplies in crevices for use in the coming season of want. Hearty, energetic, versatile, the jay at this season is worth watching. As to food, he is essentially a vegetarian by preference. Nothing suits his taste quite so well as nuts,—acorns, chestnuts, beechnuts, and similar kinds, having rather thin shells. Sometimes a flock will develop a taste for corn, and do more

or less damage as it stands in the field, but this is by no means chargeable to all blue-jays, as there are undoubtedly many that never tasted a kernel.

In spring and summer, insects, fruit, and a variety of miscellaneous matter are eaten. The jay is quite as unscrupulous as the crow, which it resembles in many ways. Birds' nests are occupied at the season when it is obliged to forage widely for supplies, and eggs and young are sometimes carried off and devoured. Just how prevalent this unfortunate habit is has not been determined, but there can be little doubt that individual jays, at least, do much damage in this manner.

THE BLUE-JAY.
(*After Biological Survey.*)

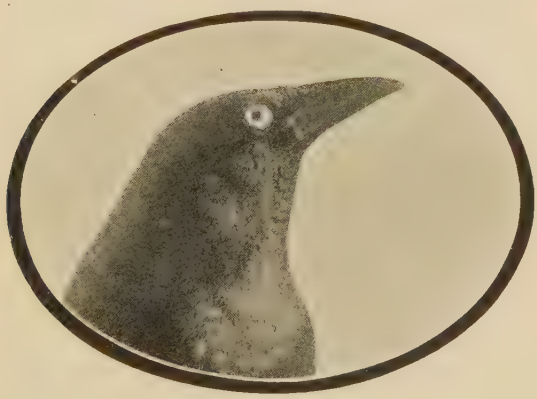
An examination of two hundred and ninety-two stomachs, collected in every month of the year from twenty-two States and the District of Columbia, made by the Department of Agriculture at Washington, showed that practically three-fourths of the food was vegetable. Forty-two per cent. of the year's average was "mast,"—a comprehensive term for nuts and large seeds of trees and shrubs. Corn was found in seventy-one stomachs and amounted to about eighteen per cent. for the year. The stomachs taken in autumn showed conclusively that these birds prefer nuts to corn.

In spring more or less fruit is consumed. In March apples frozen on the trees amounted to thirty-two per cent. Fresh fruit is taken quite largely in June and July, averaging about thirty-five per cent. for the two months. Of this strawberries, currants, blackberries, and mulberries were the only cultivated species, and none of these were taken in much quantity.

The insects eaten were mainly beetles, grasshoppers, and caterpillars. Most of the beetles belonged to the familes *Carabidæ* and *Scarabæidæ*. Grasshoppers and caterpillars are both eaten quite extensively. Walnut caterpillars (*Datana*) are sometimes destroyed in great numbers.

In this analysis only two stomachs contained traces of egg-shells of small birds, and only one, remains of young. In a few stomachs were found remains of fish, salamanders, frogs, mice, and a shrew.

Except in cases where blue-jays are actually engaged in depredations it is unwise to destroy them. As a rule, they are beneficial.



HEAD OF PURPLE GRACKLE.

CHAPTER XV.

THE FLYCATCHERS, HUMMING-BIRDS, SWIFTS, AND NIGHT-HAWKS.

THE FLYCATCHERS.

To the naturalist who wanders much afield the PHŒBE, or PEWEE, is one of the dearest of feathered friends. For it is a familiar companion in the North from spring until autumn and in the South throughout the winter. It makes its home on almost every farm, so that the sight of it evokes in the mind of every one brought up in the country tender memories of early associations. Nearly all of its food consists of insects, most of which are captured in the air. Perched upon an exposed twig or a dead mullein-stalk, the bird scans with eager eye the surrounding space, alert for any winged thing that may come within its range of vision. When a beetle or a moth flies by, the bird darts quickly towards it, snaps its capacious beak, and the career of the insect is ended. Returning at once to its perch, the phœbe waits patiently for another morsel. Thus it spends its days.

THE PHŒBE.

A careful examination of the contents of many phœbe stomachs by experts at Washington "showed that over ninety-three per cent. of the year's food consists of insects and spiders, while wild fruit constitutes the remainder." The

insects are chiefly of species injurious to man's interests, so that these feathered friends are of great utility in reducing the hordes of noxious pests.

The nest of the phœbe is built by preference upon the timbers of a bridge, with the murmur of running water just beneath. It is composed of mud and moss plastered against the side of the support. When it is completed the mother bird lays four or five white eggs, which are faithfully incubated until they hatch into hungry birdlings that keep the parents busy bringing food. The young are fed wholly with insects and their allies, including chiefly moths, grasshoppers, ants, spiders, and similar creatures.

The phœbe is so universal a favorite that it has not wanted champions wherever it is found. But the knowledge of its exceeding usefulness should win for it more friends, who shall encourage its increase in every way possible. For surely there can be no straining of the quality of mercy in protecting these feathered creatures: such mercy is thrice blessed,—for it blesses first the birds, second ourselves, and third our children and our children's children in transmitting to them undiminished Nature's heritage of man's allies.

The Kingbird is noted for its pugnacious antipathy to hawks and crows, and is esteemed by agriculturists for this quality which makes it a veritable knight of the farm. It is familiar with mankind, makes its home in the orchard, and takes no pains to hide its nest. The protection it affords against marauding birds is not more important than its benefits as an insect destroyer. Ninety per cent. of its food consists of insects, including such noxious species as May-beetles, click-beetles, wheat and fruit weevils, grasshoppers, and leaf-hoppers.

Bee-keepers have made the claim against the kingbird that it is destructive to bees, but evidence furnished by dissections tends to prove that this damage is really of slight conse-

quence. It is recorded of an Iowa apiarist that he suspected these birds of eating his bees and shot several near his hives, but when examined by an expert entomologist no bees were found in their stomachs. Of two hundred and eighty-one stomachs opened by the Biological Survey, only fourteen contained honey-bees, fifty in all, forty drones, four workers, and six undetermined. The destruction of the drones was a benefit, and the few workers were more than compensated for by nineteen robber flies that had been eaten. Small fruits, such as elder-berries, blackberries, and wild cherries, make up ten per cent. of its food. In southern Louisiana it partakes of berries of the prickly ash and tobasco peppers and is regarded as a pest by pepper-planters. This spicy diet gives its flesh a pungent flavor which makes it sought for the table, and numbers are annually killed for market. The food of the young kingbirds consists almost wholly of insects, nearly half of it being crickets and grasshoppers when these are abundant.

THE KINGBIRD.
(*After Biological Survey.*)

The other common flycatchers—the Great Crested, the Least, and the Wood Pewee—appear to have feeding habits very similar to the phœbe and the kingbird, although, of course, woodland species find insects of quite different sorts from those in cultivated spaces.

THE HUMMING-BIRD.

Only one species—the Rubythroat—of the beautiful family of humming-birds (*Trochilidæ*) occurs in the Northern States. This feathered sprite is rather common and may often be seen hovering before flowers, from which it extracts nectar and minute insects and spiders. Considerable discussion has taken place as to whether its food consisted mainly of insects or nectar: the relative proportion of the two elements probably varies with the season and locality. When the sap of trees is obtainable, the birds appear to prefer it to any other food. They regularly visit trees perforated by yellow-bellied sapsuckers: Mr. Frank Bolles says that in the White Mountains of New Hampshire, "the humming-birds, at 'orchards' where they are not molested by the woodpeckers, drink scores of times in the course of the long summer day. When not drinking they are usually perched on twigs a few yards from the holes, keeping their nervous heads wagging from side to side while watching for intruders. In a few instances I have seen humming-birds perch upon the bark below the holes, in order to drink long without being forced to keep their wings moving while enjoying the sweet sap."[1] The young are fed chiefly upon minute insects, such as gnats, ants, and small bees. According to Mr. William Brewster's observations, the young are fed by regurgitation.

THE CHIMNEY-SWIFT.

The swifts (*Cypselidæ*) are represented in eastern North America by but one species, the abundant Chimney-Swift, or Chimney-Swallow, a bird of marvellous powers of flight, with small and slender body, long, pointed wings, and not a grain of superfluous flesh: an aerial thoroughbred, built for cleaving the air in chase of the insect quarry that forms its

[1] Science, vol. xx. p. 318.

food. Before the discovery of America, when the rude smoke-holes that served as chimneys for the wigwams and long-houses of Choctaw or of Iroquois extended no invitation for these birds to nest in them, hollow trees more or less open at the top took the place of the modern chimney. In thinly settled districts of the West such trees are still used for the purpose. The nest is built of little twigs broken off from the trees while the bird is in full flight, which are stuck together and to the sides of the chimney or tree by saliva. The same nest is sometimes used for two or three seasons. A large number of birds often choose the same tree or chimney for breeding and roosting purposes.

The chimney-swifts are abroad at all hours of the day and night, but fly most freely from earliest dawn till soon after sunrise, and again before sunset till after dark. Doubtless at such times the insects on which they feed are most abundant in the air. Their food is varied, probably consisting of almost all the flying insects with which they come in contact. Three specimens studied by Professor S. A. Forbes had eaten ants, moths, ground-beetles, rove-beetles, plant-beetles, flies, bugs, and spiders. The young are fed largely upon grasshoppers when these are abundant, and at other times on various kinds of insects.

There has long been prevalent a popular idea that these birds winter in a lethargic state in chimneys and hollow trees, but all well-informed ornithologists declare this statement to be preposterous. According to Stejneger the chimney-swifts are found in Mexico in winter. It would be very strange if a bird of such powers of flight as this should choose to sleep away the cold season, instead of basking in the sunshine of the South to be reached in so short a time.

THE NIGHTHAWK AND THE WHIPPOORWILL.

The strange family of goatsuckers, or night-jars (*Caprimulgidæ*), is represented in the United States by eleven species

and subspecies, only two of which, however, are commonly found over the largest portion of our country, the others occurring in the Southern or Southwestern States. Every one is familiar with the plaintive cry of the Whippoorwill, one of the commonest members of this group. It is a nocturnal bird and secludes itself by day in the darkest recesses of the woods. In such places also the young are reared, the two creamy white, brown-blotched eggs being deposited on the ground or on a log or stump, with no attempt at a nest. By night it flies rapidly through the air, catching in its capacious mouth flying insects of many kinds. The few stomachs that have been examined show that it feeds largely on night-flying moths, sometimes taking those having a wing expanse of two inches. Click-beetles and other beetles are also often devoured. Four-fifths of the food of one specimen consisted of injurious grasshoppers. One Ontario specimen had its stomach filled with "the large female wingless ants, which could only have been obtained upon the ground, and in all probability in the daytime."[1]

The Nighthawk, or Bull-Bat, is seen much oftener than the whippoorwill, on account of its greater abundance and its habit of flying about everywhere, especially on dark days and towards dusk. Small flocks of them may frequently be seen cleaving the air in all directions, coming close to men and houses in their rapid evolutions. Its two eggs are laid on the ground, generally in secluded situations, although of late it often uses the flat roofs of Boston houses as nesting-places. It is a great insect eater, its food consisting of May-flies, dragon-flies, beetles of many kinds, "water boatmen," scorpion-flies, bugs of various sorts, and many grasshoppers. From seven Nebraska specimens Professor Aughey took three hundred and forty-eight Rocky Mountain locusts, an average of forty-nine to each bird. An Arkansas specimen examined

[1] Nash, Birds of Ontario, p. 29.

by F. L. Harvey contained more than six hundred insects,—gnats, beetles, flies, ants, and grasshoppers. Professor Herrick has found that the young are fed largely on firefly beetles.

The nighthawk frequently suffers from the thoughtless cruelty of amateur gunners who shoot at them as they fly in the air. This is unworthy "sport" for boy or man. These birds are not only very useful as insect destroyers, but, as Mr. E. B. Williamson has written, they are also "handsome birds, adding much to the twilight beauty of a summer evening as the scattered flocks pass with easy and graceful flight over fields and woodland."

THE LUNA MOTH.
Slightly reduced.

Photographed from life by Dr. R. W. Shufeldt.

THE RED-HEADED WOODPECKER.

CHAPTER XVI.

THE WOODPECKERS, KINGFISHERS, AND CUCKOOS.

THE WOODPECKERS.

In a general way each family of birds is set apart to perform certain special functions in the economy of nature. To the woodpeckers has been assigned the task of keeping in check the borers concealed beneath the bark of trees, and, incidentally, of devouring any other insects which may be scattered about the trunk and branches. With the single exception of the yellow-bellied species, all our woodpeckers appear to be eminently beneficial. The peculiarities of their structure eminently fit them for their special work: the feet generally have two toes in front and two behind, all armed with sharp claws, enabling the birds to hop up trees with ease; the tail feathers are short, stiff, and rigid, serving as a support when the bird gives hammer-like strokes with its chisel-shaped beak; and the tongue, in all except the yellow-bellied species, is extensile and generally barbed on the edges near the tip, so that it can be thrust into burrows to impale the occupants. There are about thirty forms of the Picidæ—the woodpecker family—recognized in North America. Most of them remain throughout the year in the localities in which they occur.

The Ivory-billed Woodpecker is the monarch of the family. It is a large, handsome, powerfully built bird, twenty inches long, with a wing expanse of thirty inches. Occurring only in the Southern States, it there is found in the deepest woods and swamps, far away from human habitations. The Pileated Woodpecker is a species nearly as large as the one just mentioned and has similar habits, though it is more generally distributed over the United States. Both are rare birds, inhabiting solitary forests; on account of their shyness, they

are not likely ever to have much economic importance in civilized communities. Analyses of the stomach contents of the pileated species have shown that it feeds largely on ants, beetles, and other insects which it finds in dead trees and logs, the beetle larvæ that bore into the trunks of trees being especially taken. It also feeds upon the seeds and berries of many sorts of wild fruits, such as the sour-gum, flowering dogwood, black haw, hackberry, persimmon, wild grapes, Virginia creeper, greenbrier, sumac, and poison-ivy. In the stomachs analyzed by the Biological Survey the animal and vegetable matter was about equally divided.

THE HAIRY WOODPECKER.
(*After Biological Survey.*)

Either the typical form or that of some variety of the Hairy Woodpecker occurs commonly in most parts of North America. This is a particularly useful bird, visiting freely the kings of the forest, as well as the fruit-trees of the orchard and the shade and ornamental trees of the home grounds, the park, or the public thoroughfare. It nests in holes in

trees, usually in the forest, and rears from four to six young. No birds search more persistently for the wood-boring grubs living beneath the bark of trees, many of which—like the flat-headed borer—are the most vexatious enemies of the fruit-grower. During their meanderings over the trunk and larger limbs they often startle moths and other nocturnal insects, which they devour whenever opportunity offers, and they also penetrate the disguise of many geometric caterpillars and cut short their deceptive careers. A good idea of the general diet of the species may be obtained from Professor King's statement that of twenty-one specimens examined, "eleven had eaten fifty-two wood-boring larvæ; five, thirteen geometric caterpillars; ten, one hundred and five ants; six, ten beetles; two, two cockroaches; two, nine egg-cases of cockroaches; two, two moths; one, a small snail; one, green corn; one, a wild cherry; and one, red elder-berries." More than two-thirds of the food of eighty-two specimens studied by the Department of Agriculture was animal matter, chiefly insects.

In the presence of an unusual abundance of grasshoppers the hairy woodpeckers feed freely on them; four Nebraska specimens had eaten one hundred and fifty-seven of these insects. They also do good service in penetrating the cocoons of the cecropia emperor moth, the larvæ of which devour the foliage of fruit- and shade-trees. A number of observers have reported that these birds push their beaks through the tough cocoons until the pupæ inside are reached, the juices of the latter being sucked away. They have also been credited with having in 1880 "cleaned elm-trees in Cleveland, Ohio, of the cocoons of the tussock-moth."

Concerning the beneficent habits of the hairy woodpecker, Dr. P. R. Hoy, a well-known naturalist, wrote many years ago: "Cheerful and industrious, he is always on the lookout for those worms that burrow in the substance of the wood or under the bark of trees. He is an expert at auscultation and percussion, and he is not indebted to Laennec for the art

either. As he explores suspicious localities with gentle taps, he quickly detects the evidences of unsoundness, and is not slow to learn the cause. *Worms* is his hobby: soon he chips an opening, and with his long, slender tongue, armed with a barbed lance-point,—a capital tool,—he soon extracts the cause of the evil. While engaged in 'worming' he continues to utter his cheerful *Plick, plick!* in a major key, as if conscious that he is engaged in a good cause and not ashamed

THE CECROPIA MOTH AND ITS COCOON (REDUCED).

to own it. You can always tell where he is. A few ears of corn is about all the pay he takes for his valuable work. Protect him; he is our friend."

In habits, manner, and dress the Downy Woodpecker seems but a miniature copy of its hairy cousin. It more commonly frequents orchards and is often called the "sapsucker," but this is a misnomer, as that name should be confined to the yellow-bellied species. Although it bores holes in the

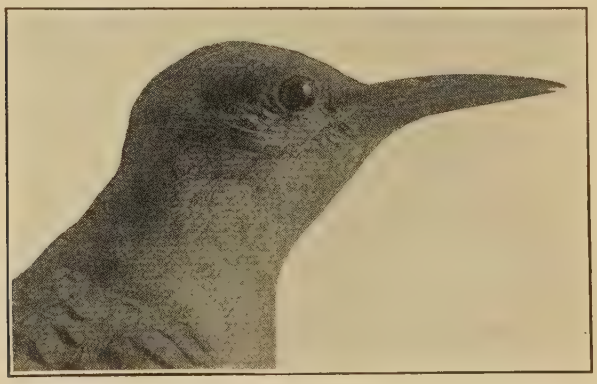
bark of apple-trees, it does not revisit them to suck the sap, according to the habit of the last-named bird; and the holes seem usually not to injure the tree. Seventeen Wisconsin specimens had eaten forty insect larvæ, including twenty wood-boring grubs and three caterpillars, seven ants, four beetles, a chrysalid, one hundred and ten small bugs, and a spider, together with a few acorns and small seeds, and a little woody fibre apparently taken by accident along with the grubs. Three-fourths of the food of one hundred and forty specimens examined by the Department of Agriculture consisted of insects. Nearly one-fourth consisted of ants, taken chiefly from those which are attending aphides or burrowing in wood. Audubon states that in autumn these woodpeckers eat poke-berries and wild grasses. Mr. W. E. Cram observed one of these birds opening the seed cases of mullein in August. "I found that seed vessels that contained grubs were brown, while those on the same stalk free from them were still green, and observed that the woodpecker only opened the brown ones." Dr. D. S. Kellicott has reported that the downy woodpecker has been "most industrious in Columbus, Ohio, in boring for the larvæ of the maple aegerian," a pest of shade-trees. Mr. A. W. Butler has "often found them feeding upon sunflower seeds, of which they are very fond."

The young birds are fed with insects, ants forming a large percentage of their diet.

The only injury that can be charged to the account of this bird is that of spreading the seeds of poison-ivy, the berries of which it eats. The seeds pass through the body unharmed as to their germinating qualities. Probably this is a chief reason why these plants are so generally found growing around the bases of trees.

The Flicker, although one of the woodpeckers, has habits quite different from the majority of its tribe. Instead of drilling holes in trees for a living, it gets most of its food from the ground. Its structure, especially that of its bill, is modified

to suit its peculiar habits. The ordinary woodpecker's bill is shaped like a chisel at the tip, but that of a flicker is like a pickaxe. It has the same long, extensile tongue which characterizes most of the woodpeckers. This is used for catching small insects, by being thrust out covered with sticky saliva and entangling them. Larger insects are grasped by the bill. Flickers relish fruit as much as robins do. The two species are usually associated when the berries of the sour-gum and black-cherry trees are ripe. In winter flickers eat the berries of Ampelopsis. Nearly half the flickers' diet consists of ants.



HEAD OF FLICKER.

In two hundred and thirty stomachs examined at Washington fifty-six per cent. was animal matter, thirty-nine per cent. vegetable, and five per cent. mineral. Two of them contained over three thousand ants each. Other insects were beetles (*Coleoptera*), bugs (*Hemiptera*), grasshoppers and crickets (*Orthoptera*), caterpillars (*Lepidoptera*), May-flies (*Ephemerida*), and white ants (*Isoptera*). In 1860 a writer in the *Southern Planter* stated that flickers were the only birds he had ever seen pulling out worms from the roots of peach-trees,—referring evidently to the destructive peach-tree borer.

The Red-headed Woodpecker is another species that, like

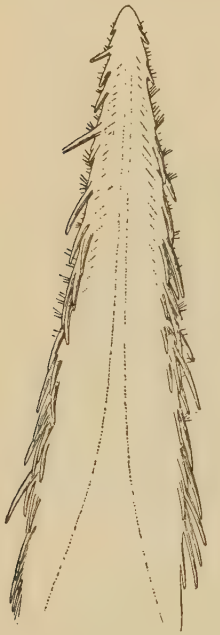
the flicker, has got above hard work. Instead of delving in wood, he sits on a post or a telegraph-pole or similar point of vantage, taking beetles, grasshoppers, and other insects which come along or are seen on the ground. At times he darts out for flying insects and captures them on the wing. He is fond of corn and nuts. In autumn these birds store nuts in all sorts of crevices for future use. It has been

THE RED-HEADED WOODPECKER.
(*After Biological Survey.*)

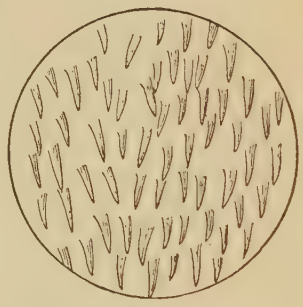
observed that in years when there are many beechnuts, red-headed woodpeckers spend the winter in the Northern States, except New England where they are rare.

About half the food taken by this species is animal and half vegetable. Beetles are eaten oftener than any other order of insects, forming about a third of the total food. Among these beetles are many carabid and tiger beetles, which, being carnivorous, are more or less useful. There are other com-

plaints against this woodpecker besides that of killing useful beetles. It sometimes devours cultivated fruits,—blackberries, strawberries, cherries, apples, pears, etc.,—thereby raising the farmer's ire, and at times robs birds' nests of their young. On the other hand, many of the beetles and other insects are harmful and most of its vegetable food is valueless. Even though it were proved that its food habits were against it, a



TONGUE OF RED-HEADED WOODPECKER.
Magnified. (*After Lucas.*)



SPINES ON ROOF OF TONGUE.
Magnified. (*After Lucas.*)

bird of its rare beauty is worth seeing now and then, though we may have to pay for the pleasure.

One of the most notable illustrations of the value of woodpeckers has been brought to light through the investigations of spruce insects in the Northeast by Dr. A. D. Hopkins, forest entomologist of the United States Department of Agriculture. Dr. Hopkins found that great damage was being

done by the spruce-destroying bark-beetle (*Dendroctonus piceaperda*), but that its work was being largely checked by woodpeckers, probably chiefly the Arctic Three-toed Woodpecker and the Banded Three-toed Woodpecker, as these species come from the far North in winter and live in northern New England in numbers. Dr. Hopkins writes: "Woodpeckers are the most important enemies of the bark-beetle, and appear to be of inestimable value to the spruce-timber interests of the Northeast. Indeed, I feel confident that in the many hundreds of infested trees examined, at least one-half of the beetles and their young had been destroyed by the birds, and in many cases it was evident that even a greater proportion had perished from this cause alone.

"Estimating one hundred beetles to the square foot of bark in the average infested tree and an average of sixty square feet of infested bark, it is possible for each tree to yield an average of six thousand individuals, one hundred trees six hundred thousand, and so on. It is therefore plain that if one-half or two-thirds of this number are destroyed by the birds and other enemies, the amount of timber the remainder can kill will be lessened. This is all the more apparent when it is remembered that it is only when the beetles occur in great numbers that they can overcome the resistance of the living trees."

In California, however, Dr. Hopkins has found the woodpeckers to be in some respects of doubtful utility in their relations to forest insects. There certain clerid beetles and other enemies of bark-borers are abundant, and are especially exposed to the attacks of woodpeckers. The result is that they are eaten to a large extent and so are prevented from killing the bark-beetles.

The Yellow-bellied Woodpecker, or true Sapsucker, either in the typical or a varietal form, occurs throughout the United States. Although seldom an abundant species, it is rather common within its range. The structure of its tongue differs

from that of its congeners: it is only slightly extensile and is not adapted for penetrating the channels of and dragging forth wood-boring larvæ. Consequently these pests are seldom found in its food. Its usual diet appears to consist of insects and berries of various sorts, together with the sap and more or less of the inner bark (cambium) of trees. Like the flicker it takes great numbers of ants, the other insects eaten including beetles, crane-flies, grasshoppers, caterpillars, and bugs. Fifteen out of thirty Wisconsin specimens had eaten nothing but ants. Of berries, wild grapes and dogwood-berries are devoured.

TONGUE OF SAPSUCKER. Magnified. (*After Lucas.*)

There can be no question that the yellow-bellied woodpecker habitually feeds upon the sap of trees: the testimony of naturalists and fruit-growers in many widely separated localities is conclusive on this point. To obtain the sap the birds make horizontal series of punctures in the bark of many trees; these holes extend through the bark and slightly into the wood. They are deeper than those made by the downy woodpecker and run horizontally around the tree, a half-inch or more apart. Two or more series, one above the other, are usually made in the trunk of the chosen tree. The sap oozes into these holes and the birds revisit them constantly to suck it up, just as the owner of a sugar-orchard visits his pails to gather the sap from the maple-trees. During recent summers we have repeatedly seen these birds thus visiting the hundreds of punctures they had made in a row of English white birches along the border of Dartmouth College park. The woodpeckers were by no means the only visitors attracted by the flowing sap: humming-birds, hornets, wasps, flies, and ants were there in abundance. The two first named were not on good terms, for whenever a ruby-throat would appear, one or more of the great white-faced

hornets would attempt, often successfully, to chase it away. But they did not interfere with the proprietors of the saccharine establishment.

These sapsuckers seem to have surprisingly little choice in the trees selected to supply their food; besides the English white birch, they puncture the common birch, sugar-maple, pignut-hickory, pine, apple, white beech, and probably many other trees. Mr. A. W. Butler, the well-known Indiana ornithologist, writes concerning this species: "They do great damage in spring to fruit- and shade-trees, especially the sugar-maple. They perforate the bark with holes arranged in bands on spirals about the trunk of the tree or larger limbs, from which the sap sometimes flows in streams. I have counted six of these birds on a dozen sugar-maples in front of one lot in my own town. In winter they are especially severe on coniferous trees. Norway pines in my yard have been girdled until they became puny, sickly trees and were cut down." Mr. Butler further reports that a friend, spending a day in the woods, "was attracted by the actions of a yellow-bellied woodpecker which had tapped a young tree near its top. It would sip the sap and then wait for it to collect and feed again. This was continued for several hours. The observer watched until five in the afternoon and left the woodpecker just where he first saw it. It had not moved more than a yard from the hole in the entire seven hours." The young of this species seem to be fed with both sap and insects.

There is no doubt that this species is undeserving of encouragement, and when it appears to be injuring valuable trees it should be shot. The fruit-grower, however, should be sure that the birds in his orchard are not of the other species, which are highly beneficial and deserving of protection.

THE KINGFISHER.

The northern United States have but one representative of the interesting family of kingfishers (*Alcedinidæ*). This is

the well-known and widely distributed Belted Kingfisher. "Amidst the roar of the cataract or over the foam of a torrent, he sits perched upon an overhanging bough, glancing his piercing eye in every direction below for his scaly prey, which with a sudden circular plunge he sweeps from its native element and swallows in an instant. His voice, not unlike the twirling of a watchman's rattle, is naturally loud, harsh, and sudden, but is softened by the sound of the brawling streams among which he generally rambles. He courses along the windings of the brook or river at a small height above the surface, sometimes suspending himself by the rapid action of his wings, like certain species of hawks, ready to pounce on the prey below; now and then settling on an old dead limb to reconnoitre. Mill-ponds are particularly visited by this feathered fisher; and the sound of his pipe is as well known to the miller as the rattling of his own hopper." So wrote Alexander Wilson many years ago; the same picture might be drawn to-day.

The kingfisher goes south late in autumn, winters in Florida and other Southern States, and returns north early in spring. Many reside at the South throughout the year. The nest is made in a horizontal burrow, five or six feet long, excavated by the birds in river or other banks. The food consists principally of fish, but occasionally mice, frogs, or grasshoppers are captured. The young are fed chiefly upon fish, but are also given various sorts of aquatic insects. The kingfisher is a handsome bird, whose presence adds much to the enjoyment of excursions—by boat or on shore—along the margins of streams and lakes, although in trout-streams it is sometimes troublesome from the point of view of the fisherman.

THE CUCKOOS.

With a large proportion of the general public the word "cuckoo" brings to mind a bird which has the habit of placing its eggs in the nests of other birds, the resulting young ousting

the rightful occupants from the nest. This picture is due to the influence of the European cuckoo upon our literature, and it by no means portrays the domestic habits of the American species, of which we have two, the YELLOW-BILLED and the BLACK-BILLED, the latter having the more northerly range.

Both of these cuckoos are shy and secluded in habits, occurring mostly in woods and underbrush along streams, but often visiting orchards and groves. They now appear to be more worthy, since their food habits have been investigated, than they were formerly held. It is a well-known fact that the common birds of the orchard, particularly the robin, expostulate loudly, and frequently show fight, when a cuckoo comes on the scene. From this it might be inferred that the cuckoo is an enemy. Some of the older writers on ornithology ascribe to it the habit of invading birds' nests. If such a habit exists, it is an exception, and not a rule. Both species feed upon practically the same matter.

YELLOW-BILLED CUCKOO.
(*After Biological Survey.*)

Fruit is seldom eaten. Of one hundred and fifty-five stomachs of cuckoos taken between May and October, inclusive, by the Biological Survey, only one contained berries. Nearly half of the food consisted of different kinds of caterpillars, mainly hairy ones.

During May and June, when tent caterpillars (*Clisiocampa americana*) are stripping orchards of everything green and leaving on the bare branches their unsightly nests, they form

nearly half of the cuckoos' fare. These birds are unique in having a taste for insects that other birds reject. Most birds are ready to devour a smooth caterpillar that comes in their way, but they leave the hairy varieties severely alone. The cuckoos, however, make a specialty of devouring such unpalatable creatures: even stink-bugs and the poisonous spiny larvæ of the Io moth are freely taken. About six per cent. of the food for the year consists of beetles, among which are a few potato-beetles. No preference for any particular sort of beetle is apparent: probably any beetles found crawling over branches of trees would be eaten. Investigation has shown scarcely more bugs (*Hemiptera*) than beetles, probably for the same reason,—both live principally on the ground,—those that were found being largely cicadas, which dwell almost wholly in trees. Grasshoppers, katydids, and tree-crickets are eaten to a considerable extent, orthopterous insects amounting to about thirty per cent. of the year's food. Flies, ants, and other hymenopterous insects are taken in small quantities.

The nestling birds are fed chiefly with smooth caterpillars and grasshoppers, their stomachs probably being unable to endure the hairy caterpillars.

All in all, the cuckoos are of the highest economic value. They do no harm and accomplish great good. If the orchardist could colonize his orchards with them, he would escape much loss.

That curious member of the cuckoo family known in the Southwest as the Chaparral Cock, or Roadrunner, is especially noted for its speed on foot and its droll manner of darting about in pursuit of its food. Its economic interest lies wholly in what it eats. Insects, snails, lizards, small birds, and snakes are food for it. It is even credited as an enemy of the rattlesnake. It is occasionally tamed and allowed to go at will about the premises to wage war on mice and other household pests, though it generally becomes so mischievous that it proves a nuisance rather than a benefit.

Photographed from life by Dr. R. W. Shufeldt.

YOUNG BARRED OWLS.

CHAPTER XVII.

THE OWLS.

Few birds make a stronger appeal to the imagination than do the owls. Their nocturnal habits, their grotesque appearance, their weird and unearthly voices, and their secluded haunts all combine to render them birds of note to the human mind. Our literature is full of allusions to the owl, such allusions, especially in the older writings, being chiefly due to the barn-owl, which in Europe commonly inhabits the belfries and towers of churches and castles.

With few exceptions the owls are nocturnal birds, though many of them can see very well by daylight. Their eyes are large and of peculiar structure, the ears are remarkably developed, and the plumage is so soft and fluffy that the birds seem much larger than they really are. Many of the species have a wide distribution, being found almost the world over under the guise of slightly varying geographical races. The nest is generally placed in a hole in a tree, the cupola of a building, or some other sheltered situation. The eggs are whitish and vary from two to eight or more, according to the species.

The owls live wholly upon animal food, which, as a rule, is captured alive. Small animals, especially mice and gophers, birds, frogs, reptiles, and the larger insects form their staple diet, though fish are sometimes caught in the water and eaten. The indigestible portions of the food are regurgitated in the form of small pellets, in which the hair and bones of the victims are all present. On this account it is an easy matter to determine precisely the food of a given species of owl by examining the pellets in the nest or beneath the roosting-site. Large numbers of such pellets have been examined by com-

petent naturalists, both in Europe and America, and the results prove beyond question that the owls as a group are of great value as vermin destroyers. The most complete account of the economic status of these birds as yet published is the report of Dr. A. K. Fisher, of the United States Department of Agriculture, to which we are indebted for much of the information in this chapter.

There is but one North American representative of the family *Strigidæ*, the common BARN-OWL of the Southern and Western States. This handsome bird is occasionally found as far north as New England on the Atlantic coast, while in the Pacific region it extends northward to Oregon. In most parts of the United States it is not an abundant species, but in California it is said to be the commonest of the owls. It nests in towers or hollow trees, depositing from three to six yellowish-white eggs on the mass of regurgitated pellets which have accumulated in its abode.

The barn-owl is a crepuscular or nocturnal bird, hiding during the day and sallying forth in search of prey during the evening. The record of its food is unusually complete, and shows that on the whole it is a very useful species. Of thirty-nine stomachs examined by Dr. Fisher, one contained a pigeon; three, other birds; seventeen, mice; seventeen, other mammals; four, insects; and seven were empty. These stomachs were collected from Delaware to California, and contained specimens of the following small mammals: meadow-mice, jumping mice, harvest and house mice, white-footed mice, shrews, cotton-rats, pocket-rats, kangaroo-rats, wood-rats, and pouched gophers. Two hundred pellets from beneath a nest of these birds in Washington, D. C., contained four hundred and fifty-four skulls, of which "two hundred and twenty-five were meadow-mice; two, pine-mice; one hundred and seventy-nine, house-mice; twenty, rats; six, jumping mice; twenty, shrews; one, a star-nosed mole; and one, a vesper-sparrow."

Mr. J. H. Reed, who has made a special study of the barn-owls in Pennsylvania, says that their food consists chiefly of meadow-mice.

A German ornithologist thirty years ago examined seven hundred and three pellets regurgitated by barn-owls. Of the two thousand five hundred and fifty-one skulls found, one thousand five hundred and seventy-nine belonged to shrews, nine hundred and thirty to mice, sixteen to bats, one to a mole, nineteen to English sparrows, and three to other birds.

In the Southern States the barn-owl feeds very largely upon the destructive cotton-rat, and in California the main staple of its diet is the pouched gopher, an abundant and vexatious rodent, and the ground-squirrel, a related pest. All accounts agree in showing that it is a rare and exceptional trait for the barn-owl to feed on small birds.

The Short-eared Owl is said to have the greatest geographical range of any land bird. It is found in all the principal divisions of the globe except Australia, and is common throughout most of North America, going northward to breed in summer and returning southward for the winter. It prefers open to wooded country, and in many regions is the most abundant of the owls. Its food consists principally of field-mice, but moles, shrews, gophers, small rabbits, crickets, grasshoppers, beetles, and rarely small birds are also eaten. Fully ninety per cent. of the stomachs of about fifty specimens examined in the Department of Agriculture contained nothing but meadow-mice. In England this species is noted as being one of the chief agencies in subduing the uprisings of field-mice that periodically occur.

The Barred Owl is a larger bird than either of the preceding species. The typical form is found in eastern North America, while closely related representatives inhabit the West and Southwest. It is generally accused of being a serious enemy to poultry, and in southern regions where

fowls roost in trees it probably does considerable damage; but of the one hundred and nine stomachs examined by Dr. Fisher only three contained domestic fowls, while in one was a pigeon, in another a ruffed grouse, and thirteen contained smaller birds, including screech-owls, sparrows, and a red-bellied woodpecker. Mice were found in forty-six stomachs; rats, red squirrels, and chipmunks in eighteen; insects and spiders in sixteen; crawfish in nine; frogs in four; fish in two; a lizard in one; while twenty of the stomachs were empty. Audubon records the fact that these owls are very fond of a brown wood-frog found in Louisiana. "Dr. C. Hart Merriam took the remains of at least a dozen red-backed mice from a single specimen killed near Moose River in northern New York."

"In summing up the facts relating to the food habits of this owl," writes Dr. Fisher, "it appears that, while the general statements of certain authors, especially the earlier ones, charge the bird with the destruction of poultry, game, and small birds, such destructive habits are comparatively uncommon. That it does occasionally make inroads upon the poultry-yard and does more or less damage among game-birds is true; but the systematic collection and examination of a large number of stomachs show the exceptional character of such acts and reveal the fact that a large part of its food consists of mammals. And it is to be noted that among the list are some of the most destructive rodents that the farmer has to contend with. If a fair balance be struck, therefore, it must be considered that on the whole this owl is beneficial, and hence should occupy a place on the list of birds to be protected."

The barred owl makes its nest in hollow trees or among the upper branches. It often uses the deserted nest of a crow or hawk for the purpose, remodelling it slightly to suit the new occupant. The complement of whitish eggs is usually two or three, but four or five are sometimes found. These

owls prefer heavy woodlands or wooded swamps—such as the cypress swamps of our South Atlantic regions—where they may be found much oftener than in more open regions.

The Screech-Owl is one of the best-known and most abundant of the group: it inhabits all parts of the United States, and is found throughout southern Canada. It is one of the most beneficial birds of prey and deserves the encouragement and protection of farmers everywhere. Its food is varied, consisting of insects, crawfish, frogs, fish, lizards, small birds, and especially mice, of which it destroys enormous numbers. In summer insects form a large part of its fare: an owl in captivity has shown a fondness for caterpillars, and the stomachs of two examined in New Jersey were full of full-grown nymphs of cicadas or harvest-flies. In warm winter weather it stores up in its hiding-place mice, moles, and similar creatures to serve as food during more inclement periods. The only bad habit attributed to it is that of occasionally catching small birds, but since the introduction of the English sparrow this trait is favorable to the owl's usefulness, since it is known to prey to a considerable extent upon these unwelcome immigrants. In the nest of a screech-owl at Columbus, Ohio, were

SCREECH-OWLS.
(*After Biological Survey.*)

found the bodies of two English sparrows and one field-mouse.

The Long-eared Owl is a common and widely distributed species in North America. In some parts of the Southwest it is considered the most abundant of the owls; and the testimony of all competent observers points to the fact that it is one of the most beneficial members of its family. That its food consists very largely of mice is shown by the fact that out of one hundred and seventy-six skulls taken by Dr. Fisher from beneath the roosting-site of one of these owls, one hundred and thirty-seven were of mice of various species, while twenty-six were of shrews, the remaining thirteen consisting of eleven sparrows, one warbler, and one bluebird. The same observer found that out of one hundred and seven stomachs from many parts of the country eighty-four contained mice; five, other small mammals; sixteen, small birds, one being a quail; while one contained insects and fifteen were empty. Dr. B. H. Warren found that twenty-two out of twenty-three Pennsylvania long-eared owls had eaten only mice, while the twenty-third one had taken beetles and a small bird. The remains of eight field-mice were taken from the stomach of one specimen by Mr. Townend Glover; while in Oregon

AMERICAN LONG-EARED OWL.
(*After Biological Survey.*)

Captain C. E. Bendire found the food to consist principally of mice and the smaller rodents.

The long-eared owl commonly breeds in trees, using the deserted nest of a hawk or crow for the purpose. From three to six eggs are deposited. It is a nocturnal bird, hiding in groves of evergreens and other sheltered retreats during the day.

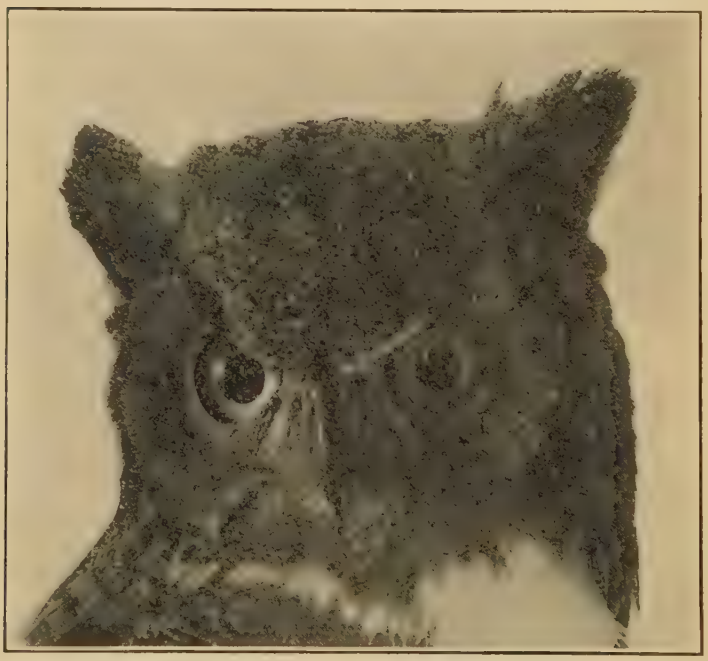
There are a number of very small owls in the United States. In the South and Southwest are found two species of pygmy owls, usually less than seven inches long; while in Arizona occurs the little Elf Owl, the smallest species of its family in North America. These owls feed upon insects, the smaller mice, and occasionally small birds.

In the Eastern and Northern States the smallest owl is the Acadian or Saw-Whet Owl, a bird usually about eight inches long, which is occasionally found from Canada as far south as North Carolina. Its nest is built in hollow trees, generally in holes made by flickers, during early spring. Its food consists chiefly of mice and shrews, with the addition of insects in summer, and an occasional sparrow or other small bird. The young are fed chiefly upon mice of various kinds and small birds.

The Great Horned Owl is found over almost the whole of North America. In strength and ferocity it has no equal among our rapacious birds. Of all the owls which we have, it is the only one distinctly harmful. During the day it keeps very closely hidden, more to escape persecution from crows and other birds that delight to torment it than because the light of day is painful to it. As a matter of fact, there is scarcely a keener-visioned creature in the woods than this owl, in spite of the general impression that it cannot see well when the sun shines.

Its food consists mainly of mammals and birds, though it sometimes catches insects. A specimen examined by us had eaten a caterpillar (*Eacles imperialis*) in addition to a chicken.

Nocturnal mammals are frequent victims. Four out of every five of these owls that are brought in have been scented by a skunk. Two nests that have come under the writers' observation both had the remains of skunks upon them beside the young. Rabbits are caught in large numbers. Musk-rats, rats, mice, and shrews are on the regular bill of fare. Many birds are snatched from their roosts and borne away by this



HEAD OF GREAT HORNED OWL.

literally "silent messenger." The ruffed grouse is often taken. Farmers who carelessly allow their turkeys, chickens, or guinea-fowls to roost on fences and trees are frequently made to repent. The writers have known an owl to dispose of two guinea-hens in one night, leaving only a few bones and a lot of feathers on the snow to tell the tale. In his account of

this owl, Dr. C. Hart Merriam[1] states that he has known one to decapitate three turkeys and several hens in a single night, leaving the bodies fit for the table.

It occasionally catches fish. Of one hundred and twenty-seven stomachs of the great horned owl that were examined at the Department of Agriculture, thirty-one contained poultry or game-birds; eight, other birds; thirteen, mice; sixty-five, other mammals; one, a scorpion; one, fish; ten, insects; and seventeen were empty.

In the arctic regions of North America the beautiful Snowy Owl is a rather common species. It is one of the largest members of its family, often being more than two feet long. In winter it is occasionally found in the Northern States, especially in New England, but during summer it remains in the far North.

The summer food of this bird consists very largely of the small rodents known as lemmings, which abound in most arctic regions. These and related rodents seem to be the favorite food except in winter, when other animals, including the ptarmigan and arctic hare, are eaten. During its winter visits to southern Canada and the Northern United States, it lives upon rabbits, rats, mice, and various birds. It is expert in catching fish, which form a favorite article of food.

The snowy owl is so rare in our country that it has little economic importance, but it probably deserves to be left unmolested when it visits us.

The Burrowing Owl is found in some parts of Florida, but is best known on the Great Plains, where it is abundant, living in prairie-dog towns and the burrows of ground-squirrels. Its food is varied, but consists chiefly of rodents, young rabbits and prairie-dogs, chipmunks, gophers, mice, and shrews. It also feeds on grasshoppers, crickets, beetles, scorpions, and centipedes. In localities where prairie-dogs

[1] Birds of Connecticut, 1877, p. 97.

are plentiful, the young ones form a large share of the food of this species.

The old story of how these owls live in harmony with prairie-dogs and rattlesnakes, all in the same burrows, is a

BURROWING OWL.
(*After Biological Survey.*)

myth. The owl and the snake are both parasites, the dog, an unwilling host, being forced to yield its home and often its life to its unwelcome guests.

SPARROW-HAWKS.

(*After Biological Survey.*)

CHAPTER XVIII.

THE HAWKS, EAGLES, KITES, AND VULTURES.

THE HAWKS.

The Sparrow-Hawk is one of the most abundant species of its family in many parts of North America. It is a small and handsome hawk, and breeds throughout the United States, as well as in Mexico on the south and in Canada on the north. It goes south in autumn, occasionally passing the winter as far north as southern New York. Its nest is built in holes in trees, those made by the larger woodpeckers often being appropriated for the purpose, and five eggs are usually deposited. It is a valuable bird and deserves protection and encouragement. Dr. A. K. Fisher, who made a special study of its economic relations, writes that it "is almost exclusively insectivorous, except when insect food is difficult to obtain. In localities where grasshoppers and crickets are abundant, these hawks congregate, often in moderate-sized flocks, and gorge themselves continuously. Rarely do they touch any other form of food until, either by the advancing season or other natural causes, the grasshopper crop is so lessened that their hunger cannot be appeased without undue exertion; then other kinds of insects and other forms of life contribute to their fare, and beetles, spiders, mice, shrews, small snakes, lizards, or even birds may be required to bring up the balance." In the sparse pine woods of the sandy barrens of southern Florida we have found the sparrow-hawk one of the commonest of winter birds, and much more abundant than any other hawk. One of its favorite methods of obtaining food there is to perch in trees on the outskirts of the forest fires that frequently occur, and catch the grasshoppers, lizards, and other animals driven from cover by the flames. At such

times lizards enter largely into the bird's diet. Professor King reports that of seven sparrow-hawks which he examined in Wisconsin "two had eaten two mice; four, twenty-five grasshoppers; three, twenty-five crickets; one, six beetles; one, five moths; and one, two hairy caterpillars. One was seen to take a young robin from the nest and one to capture another bird not identified." Ten Nebraska specimens examined by Professor Aughey had eaten large numbers of insects, comparatively few being locusts; three of them had also eaten mice, three others gophers, one a rabbit, one a quail, one an unidentified bird, and one some frogs. All the evidence goes to show that the sparrow-hawk preys only to a limited extent upon our native insectivorous birds.

The Broad-winged Hawk is comparatively a common species throughout eastern North America, spending the winter south of the fortieth degree of latitude, but coming north for the summer. It breeds in trees, building a bulky nest similar to that of other common hawks; and feeds on mice, frogs, small snakes, toads, crayfish, chipmunks and red squirrels, earthworms, and many insects,—making a specialty among the latter of the large caterpillars of the sphinx- and emperor-moths, such as the cecropia-caterpillar so often destructive to shade-trees. This is one of the few birds that venture to attack these formidable-looking creatures. This hawk very seldom attacks poultry or small birds.

Several species of the birds of prey are of great benefit to man as insect destroyers. In the Western States none of them surpasses in this respect the common Swainson's Hawk, a large bird which during the late summer and early autumn months feeds to so great an extent on grasshoppers and their allies that it might well be called a grasshopper hawk. The evidence on this point is abundant and conclusive, as is also that in regard to the work this bird does in destroying ground-squirrels (*Spermophiles*) and related pests. Flocks of several hundreds of these hawks have repeatedly been seen foraging

for grasshoppers, and from examinations of many stomachs it is safe to say that each bird during the grasshopper season destroys at least two hundred of the pests each day. They very rarely attack poultry or birds of any kind, and unquestionably deserve the protection of the husbandman.

Of the various birds to which the name hen-hawk is occasionally applied it is least deserved by the Rough-legged Hawk. All the evidence obtainable goes to show that this species is not in any sense a hen-hawk, but that instead it is a mouse-hawk, feeding almost exclusively upon meadow-mice. Forty out of forty-nine stomachs examined at the United States Department of Agriculture contained mice, while five of them contained such small mammals as shrews, gophers, rabbits, and weasels, one contained insects and a lizard, and four were empty. No poultry or birds of any kind were found. Similar testimony from many other sources has been published; in Massachusetts hundreds of these birds were killed along the Connecticut River, and all the stomachs examined contained only meadow-mice; in Oregon, Utah, and Nebraska field-mice are reported as the staple diet, while cotton-tail rabbits, gophers, and other animals are also included in the bill of fare.

The rough-legged hawk is a northern bird in summer, as a rule visiting the United States only in winter. It is said generally to keep south of the snow line in order to capture its favorite prey more easily. It hunts in the twilight, watching for victims from some low perch or slowly flying over meadows and marshes. It breeds in the far North.

The typical form of the Red-shouldered Hawk is common in the Eastern States and closely related races are found in the South and West, though the bird is absent from the Great Plains region. It breeds throughout its range, the nest being built in early spring in the upper branches of some tall tree, and a brood of from three to five young being reared. This is a heavy, slow-flying hawk, an adept at catching mice

and frogs, but paying little attention to poultry or small birds. It takes a great variety of food: two hundred and twenty specimens, taken during every month of the year in thirteen widely separated States, Territories, and Provinces, were examined by Dr. Fisher. Two of these contained chickens, with a fair probability that they had not been killed by the hawk; one, a quail; twelve, other birds, including a flicker, meadow-lark, screech-owl, Carolina dove, snow-bird, sora rail, robin, crow, and various sparrows; one hundred and two, mice, including the house, pine, field, white-footed, red-backed, and meadow varieties, chiefly the latter; forty had eaten other mammals, among which were the musk-rat, chipmunk, skunk, rabbit, opossum, and various shrews; twenty contained reptiles, including ribbon, water, striped, garter, and green snakes, as well as lizards; thirty-nine had eaten batrachians, principally frogs, though toads, tree-frogs, and salamanders were also present; ninety-two contained insects, the most important element being grasshoppers and crickets, although large caterpillars, beetles, white grubs, katydids, cicadas, and cockroaches were also present; sixteen of the hawks had eaten spiders; seven, crawfish; one, earthworms; two, offal; three, fish; while fourteen stomachs contained nothing. Such a showing as this ought to convince any one of the general beneficence of a bird whose food consists of sixty-five per cent. of mice and not more than one per cent. of poultry.

The typical form of the Red-tailed Hawk is found in eastern North America, ranging west as far as the Great Plains, while five closely allied geographical races occupy the western portion of the continent from Central America northward. It is one of our larger hawks, usually measuring nearly or quite two feet in length and having a wing expanse of four or five feet. It is a migratory species, often travelling in large flocks and spending the winter in the Central and Southern States. In many regions it is common and is often persecuted as a hen-hawk.

Our knowledge of the feeding habits of this species is unusually complete. Besides the isolated observations of a large number of competent observers, we have the results of the special studies of Dr. B. H. Warren, in which the contents of one hundred and seventy-three stomachs were examined, and Dr. A. K. Fisher, who studied five hundred and sixty-two stomachs from twenty-six widely separated States, Territories, and Provinces, ranging from Ontario to Florida and Massachusetts to California. Dr. Warren found mice in one hundred and thirty-one of the one hundred and seventy-three stomachs he examined, while six of them contained rabbits; three, red squirrels; two, skunks; and eighteen, small birds. Poultry was found in four specimens, insects in three, snakes in three, and carrion in four. Thus, less than ten per cent. of the birds had eaten poultry. Dr. Fisher's results as to poultry were similar; fifty-four out of the five hundred and sixty-two specimens contained poultry or game-birds. Various other birds, as the robin, mourning-dove, crow, shore-lark, king-rail, meadow-lark, oriole, blue-bird, grackle, screech-owl, and several species of sparrows, were found in fifty-one stomachs. Mice—including the house, meadow, pine, white-footed, harvest, and Cooper's mice—had

RED-TAILED HAWKS.
(*After Biological Survey.*)

been eaten by two hundred and seventy-eight of the birds; while other small mammals—as the gray, red, and rock squirrels, the gray, striped, and pouched gophers, chipmunks of various species, the musk, cotton, kangaroo, and common rats, three kinds of rabbits, as well as shrews and skunks—were found in one hundred and thirty-one stomachs. Frogs, toads, lizards, and snakes had been eaten by thirty-seven of the hawks; insects, chiefly grasshoppers, by forty-seven; crawfish by eight; centipedes by one; and offal by thirteen; while eighty-nine of the stomachs were empty.

That this hawk on the whole does considerably more good than harm there is no doubt, but the balance in its favor is not so great that it is worth while to extend to it too much protection in thickly settled communities.

There are three species of hawks whose bill of fare consists principally of birds and poultry. They are the sharp-shinned hawk, Cooper's hawk, and the American goshawk. To these three birds is largely due the obloquy which rests upon the family as a whole. They are all trimly built birds, strong of wing and foot, and inveterate enemies of other birds. Their only redeeming features are that they occasionally capture a rabbit, a mouse, or an English sparrow.

The Sharp-shinned Hawk is the smallest of the three, measuring from ten to fourteen inches in length. It is common and widely distributed, breeding throughout the United States and British Provinces, and migrating with the changing seasons. It passes the winter as far north as the fortieth parallel. More than any other hawk this species seems to feed on birds. Dr. Fisher examined one hundred and seven stomachs which contained food; in six of them were the remains of poultry or game-birds and in ninety-nine of them were the remains of other birds; all but two had eaten birds of some kind. Mice had been eaten by six of them and insects by five. The variety of birds taken was surprising; besides the young or half-grown chickens there were evidences

of the presence of the quail, robin, oriole, swift, bluebird, downy woodpecker, flicker, cow-bird, mocking-bird, cat-bird, oven-bird, hermit-thrush, mourning-dove, chickadee, snow-birds, and various wrens, warblers, buntings, and sparrows, including the English variety of the latter. No bird with such a record deserves protection.

Cooper's Hawk may be considered a larger type of the sharp-shinned species. It measures from fourteen to twenty inches in length, is found throughout North America as far north as the British Provinces, migrates south to spend the winter, and is an inveterate enemy to poultry, game and other birds. Of ninety-four food-containing stomachs examined by Dr. Fisher poultry or game-birds were found in thirty-four and other birds in fifty-two stomachs. Small mammals, including two mice, one cotton-rat, three chipmunks, one red squirrel, one gray squirrel, one ground-squirrel, and one rabbit, had been eaten by eleven of the hawks. Two others had taken insects, one a frog, and three had eaten lizards. The game-birds destroyed included pigeons, quail, and ruffed grouse, and on the list of other birds one finds the chewink, purple grackle, meadow-lark, flicker, nuthatch, hermit-thrush, dove, robin, snow-bird, mourning-dove, and various warblers and sparrows.

COOPER'S HAWK.
(*After Biological Survey.*)

This species is, as Dr. Fisher remarks, "pre-eminently a chicken-hawk. Its devastations in this direction are much greater than those of all the other hawks and owls together, with the possible exception of the sharp-shinned hawk, which attacks much smaller chickens." This bird is also learning to add the English sparrow to its bill of fare.

The Goshawk is not a common species in the United States, although in winter it is occasionally found. It is a northern bird, occurring frequently in the British Provinces, where it breeds. It feeds largely on good-sized birds, such as chickens, ruffed grouse, quail, and mourning-doves, as well as on rabbits, squirrels, mice, and sometimes the larger insects. It can scarcely be ranked as a beneficial bird in cultivated regions.

It is fortunate that the Duck-Hawk is a rare species, because it is a savage bird, extremely destructive to other birds of many kinds. It is a powerful hawk, of good size, our form being simply a geographical race of the famous peregrine falcon of Europe. As its common name implies, it feeds largely on water-fowl, and is seldom found far away from the coast or the neighborhood of large bodies of water. When a pair breed in the vicinity of a poultry yard,—a rare event,—the chickens are liable to suffer severely.

Among its other feathered victims one finds the meadow-lark, robin, cat-bird, mourning-dove, gray-cheeked thrush, and various warblers and sparrows. In Florida it feeds largely upon the coot, enormous numbers of which still inhabit the inland lakes. At times it is very destructive to terns along the Atlantic coast.

The beautiful Osprey, or Fish-Hawk, is of chief interest on account of its relations to the bald eagle, which so persistently robs the osprey of its prey in mid-air. The fish-hawk is chiefly a bird of the shore-line, where it finds its food abundant.

The Marsh Hawk, sometimes also called the Marsh Harrier, inhabits almost the whole of North America, breeding

Photographed from life by Dr. R. W. Shufeldt.

HEAD OF OSPREY.

from Cuba to Alaska. It is most abundant in the prairie States. The nest is placed upon the ground in marshy situations, where grass and sedges help conceal it. From four to six young are reared in each brood. This is one of the most useful of the hawks and deserves man's protection. "Its food," writes Dr. Fisher, "consists largely of small rodents, such as meadow-mice, half-grown squirrels, rabbits, and ground-squirrels. In fact, so extensively does it feed upon the last-named animals, that the writer rarely has examined a stomach from the West which did not contain their remains. In addition to the above, it preys upon lizards, frogs, snakes, insects, and birds; of the latter, the smaller ground-dwelling species are usually taken. When hard pressed it is said to feed on offal and carrion; and in spring and fall when water-fowl are abundant it occasionally preys upon the dead and wounded birds left by gunners." The stomach of a specimen shot at Hanover, New Hampshire, in 1892, when grasshoppers were very abundant, which we examined, was full of these insects, showing that the bird was doing what it could to check the outbreak. In the Southern rice-fields these birds do good service in scaring away the flocks of bobolinks. The marsh hawk is the farmer's friend, and its rare visits to the poultry-yard may well be excused on account of the enormous number of vermin it destroys.

THE EAGLES.

Bald Eagles are usually seen about the coast and larger inland waters, where they are able to find a supply of such food as best suits their taste.

In the North they live almost exclusively upon fish, showing little or no regard for quality or condition, generally devouring any sort of fish that may come in their way, and are seemingly as well satisfied with a half-decayed subject washed up by the waves as with one freshly killed. In the Southern States, where water-fowl congregate in vast numbers during

the winter months, their food relations are somewhat modified, as is indicated by the following extract, written by Dr. William L. Ralph and published in Bendire's "Life Histories of North American Birds." Speaking of a community of bald eagles in the vicinity of Merritt Island, he says: "These eagles seem to breed earlier than those in other parts of Florida, due no doubt to the immense number of water-fowl, especially coots (*Fulica americana?*), that frequent this vicinity during the winter, and which form the principal part of their food, though they will sometimes condescend to eat fish, like their more northern brothers and sisters. I have often seen them catch wounded birds, and I visited one nest that contained in addition to two well-grown young birds the remains of thirteen coots and one catfish."

The GOLDEN EAGLE inhabits mountainous districts throughout the country, though it is more common West than in the East, where it is rare, owing to the denser population.

It preys on grouse, ducks, hares, ground-squirrels, and other creatures of similar size, and occasionally troubles sheep-owners by carrying off young lambs. Sometimes it eats carrion, but probably only when pressed by hunger.

The thrilling stories told of the fierceness of this eagle are not credited by those who have invaded its nests; yet its power is unquestioned. An instance is recorded in which one throttled and killed a black-tailed deer that had been crippled by a hunter.

If this were an abundant species, it would plainly be a harmful one; but, owing to its scarcity, its depredations are generally insignificant.

THE KITES.

The kites are a branch of the hawk family especially noted for the ease and elegance of their flight. The commonest and most widely diffused species is the SWALLOW-TAILED KITE, which has a geographical range from Pennsylvania to Minnesota and southward. Six stomachs of this kite opened by

Dr. A. K. Fisher showed sixty locusts and five other insects in one, sixty-nine locusts and three other insects in another, and seventy-five locusts in a third. Lizards were found in two and a tree-frog in one. All contained insects—wasps, beetles, and grasshoppers being among them. Aughey reports of three stomachs that two of them contained sixty and sixty-nine locusts respectively, while the third contained seventy-five other insects.

All the evidence tends to prove the swallow-tailed kite to be harmless at least and generally beneficial. Two other species, the white-tailed and Mississippi kites, have practically the same bill of fare, which besides the animals above noted is sometimes varied with snakes and mice.

THE BUZZARDS.

No birds are more familiarly known throughout the Southern States than the Turkey-Buzzard and the Black Vulture or Carrion Crow. These birds may be seen at all hours of the day sailing through the air in majestic circles or lazily resting on stumps or trees after a feast of their filthy food. They perform an important service as scavengers, disposing of all sorts of animal matter that would pollute the air. On this account, they are seldom molested by man and in some States are protected by law. They devour both fresh and putrid meat, and in many localities save the butchers the trouble of disposing of the refuse of the abattoir. They are known sometimes to capture live snakes and to attack helpless animals of many kinds. Along the sea-shore they feed upon dead fish cast up by the waves, and Audubon reports having observed them in the Florida Keys sucking the eggs and devouring the young of herons and cormorants. As another offset to the good these birds do, mention should be made of the fact that Mr. E. B. Williamson has suggested that they are "doubtless an important factor in the spread of some diseases,—hog cholera, for example."

It was formerly supposed that these birds discovered their food through the sense of smell, but a number of experiments by Audubon seem to prove conclusively that they depend upon sight rather than smell. In one of these experiments "a dead hare, a pheasant, and a kestrel, together with a wheelbarrow full of offal from the slaughter-pens, were deposited on the ground at the foot of my garden. A frame was raised above it at a distance of twelve inches from the

TURKEY-BUZZARDS.
(*After Brehm.*)

earth; this was covered with brushwood, allowing the air to pass freely beneath it so as to convey the effluvium far and wide." Although left for nearly a month, with hundreds of vultures passing over it daily, none of them discovered its presence. Another time a perfectly dry stuffed deerskin was placed in a field, and immediately attracted the vultures, which were of course unable to get any food. To test still further whether the birds were attracted by sight alone, "a

coarse painting on canvas was made, representing a sheep skinned and cut open. This proved very amusing. No sooner was the picture placed on the ground than the vultures observed it, alighted near, walked over it, and some of them commenced tugging at the painting. They seemed much disappointed and surprised, and after having satisfied their curiosity, flew away. This experiment was repeated more than fifty times, with the same result." In other cases pieces of meat were placed beneath tables and other pieces

THE BLACK VULTURE.
(*After Brehm.*)

on top. The vultures would eat those in sight, but made no attempt to reach those just beneath their noses.

The way in which vultures from far and wide rapidly concentrate on a dead animal is explained by Audubon by the fact that, when the first discoverer pounces down upon its prey, the action is seen and understood by others in the vicinity; these fly immediately to the spot. As they start they are seen by others, which in turn signal to more distant birds, so that in a very short time the vultures for miles

around are aware that something in the shape of food has been found.

The turkey-buzzard is a summer and winter resident throughout the United States as far north as the latitude of 40 degrees, and occurs in summer still farther north. For instance, it is abundant throughout the year in southern Illinois, and is sometimes seen in summer in northern Illinois. It is a more graceful bird than the carrion crow. In the breeding season each female lays two eggs on the ground or in a hollow tree or stump.

The black vulture is darker colored than the turkey-buzzard and the feathers extend farther up on the back of the neck. Its nesting habits are similar to those of the other species. It is not commonly found so far north as the turkey-buzzard, although like that bird it is abundant in Central and South America.

These birds both belong to the family *Cathartidæ*, which is composed of the American vultures. The only other member of the family occurring in the United States is the Californian condor, a large bird found on the Pacific coast with habits similar to those of the turkey-buzzard.

From specimens mounted by Frank Blake Webster.

A FAMILY OF RUFFED GROUSE.

CHAPTER XIX.

THE PIGEONS, GROUSE, AND SHORE-BIRDS.

THE PIGEONS.

Most educated Americans are familiar with accounts of the enormous numbers of Passenger Pigeons which formerly inhabited many of our States. Some of the stories seem almost incredible, but there can be no doubt that they are substantially true. Audubon's graphic description is well worth quoting in this connection.

"Let us now inspect the places of nightly rendezvous. One of these curious roosting places on the bank of the Green River in Kentucky I repeatedly visited. It was, as is always the case, in a portion of the forest where the trees are of great magnitude and where there was little underwood. I rode through it upward of forty miles, and, crossing it in different parts, found its average breadth to be rather more than three miles. My first view of it was about a fortnight subsequent to the period when they had made a choice of it, and I arrived there two hours before sunset. Few pigeons were to be seen, but a great number of persons, with horses and wagons, guns and ammunition, had already established encampments on the borders. Two farmers from the vicinity of Russelsville, distant more than a hundred miles, had driven upward of three hundred hogs to be fattened on the pigeons which were to be slaughtered. Here and there the people employed in plucking and salting what had already been procured were seen sitting in the midst of large piles of these birds. The dung lay several inches deep, covering the whole extent of the roosting place like a bed of snow. Many trees I observed were broken off at no great distance from the ground; and the branches of many of the largest and tallest had given

way, as if the forest had been swept by a tornado. Everything proved to me that the number of birds resorting to this part of the forest must be immense beyond conception. As the period of their arrival approached, their foes anxiously prepared to receive them. Some were provided with iron pots containing sulphur, others with torches of pine knots, many with poles, and the rest with guns. The sun was lost to our view, yet not a dozen had arrived. Everything was ready and all eyes were gazing on the clear sky which appeared in glimpses through the tall trees. Suddenly there burst forth a general cry of 'Here they come.' The noise which they made, though yet distant, reminded me of a hard gale at sea passing through the rigging of a close-reefed vessel. As the birds arrived and passed over me, I felt a current of air that surprised me. Thousands were soon knocked down by the pole men. The birds continued to pour in. The fires were lighted, and a magnificent as well as wonderful and almost terrifying sight presented itself. The pigeons arrived by thousands, alighted everywhere, one above another, until solid masses as large as hogsheads were formed on the branches all around. Here and there the perches gave way under the weight with a crash, and falling to the ground destroyed hundreds of the birds beneath, forcing down the dense groups with which every stick was loaded. It was a scene of uproar and confusion. I found it quite useless to speak or even to shout to those persons who were nearest to me. Even the reports of the guns were seldom heard, and I was made aware of the firing only by seeing the shooters reloading.

"No one dared to venture within the line of devastation. The hogs had been penned up in due time, the picking up of the dead and wounded being for the next morning's employment. The pigeons were constantly coming, and it was past midnight before I perceived a decrease in the number of those that arrived. The uproar continued the whole night; and, as I was anxious to know to what distance the sound reached,

I sent off a man accustomed to perambulate the forest, who, returning two hours afterwards, informed me he had heard it distinctly when three miles distant from the spot. Towards the approach of day the noise in some measure subsided. Long before objects were distinguishable, the pigeons began to move off in a direction quite different from that in which they arrived the evening before, and by sunrise all that were able to fly had disappeared. The howlings of the wolves now reached our ears, and the foxes, lynxes, cougars,

THE MOURNING-DOVE.
(*After Biological Survey.*)

bears, raccoons, opossums, and polecats were seen sneaking off, whilst eagles and hawks of different species, accompanied by a crowd of vultures, came to supplant them and to enjoy their share of the spoil.

"It was then that the authors of all this devastation began their entry amongst the dead, the dying, and the mangled. The pigeons were picked up and piled in heaps until each had as many as he could possibly dispose of, when the hogs were let loose to feed upon the remainder."

The food of the passenger pigeon is almost wholly of a vegetable nature, although occasionally a few insects are eaten. Its usual diet consists of acorns and other nuts, together with seeds and grains. Even the young are fed upon beechnuts. In the United States the passenger pigeon is now practically an extinct bird, the ruthless persecution it has endured having led to this result.

The Mourning or Carolina Dove is a beautiful bird whose plumage and habits entitle it to high consideration. It is vegetivorous, but seems to feed more freely on the seeds of weeds than on cultivated grains. Professor King took four thousand and sixteen seeds of pigeon-grass (*Setaria*) from the stomach of a single bird, while from that of another seven thousand five hundred seeds of oxalis have been taken. The young are fed with the regurgitated vegetable food of the adult.

The Band-tailed Pigeon (*Columba fasciata*), which ranges westward from the Rocky Mountains and southward through Mexico, is about the only pigeon that we now have worthy to be called game. It is sought by sportsmen both for its flesh and for its gamy qualities. Its food consists of grain, berries and other soft fruits, and buds of certain trees, notably of balsam-poplar.

THE PARTRIDGE AND GROUSE.

The Bob-White, or Quail, is found from Minnesota to Texas and eastward. It is favorably regarded by epicures and gunners and deserves the good will of those interested in agriculture. It lives in fields and pastures and during the summer feeds largely on insects. Colorado potato-beetles are frequently eaten: one hundred and one of these pests have been taken from the stomach of one bird. Army-worms are also devoured. When insects are not plentiful, vegetable matter, which is always taken in greater or less quantities, becomes the staple form of diet. This includes grains, seeds,

nuts, berries, and green leaves. Twenty-one quail taken in Nebraska between May and October had all eaten seeds and from thirty-one to forty-seven insects each. Of two taken in New Hampshire in the winter when the ground was covered with snow, and examined by us, one had eaten seven oats, ten barberries, one poison-ivy seed, and some bits of green leaf that were not determined; the other had eaten twenty-five oats, twelve barberries, seven small seeds, and

THE BOB-WHITE OR QUAIL.

nine leaves of white clover. The oats had evidently been taken from horse droppings in the road near by. According to the studies of the Department of Agriculture, "seeds of rib-grass, tickfoil, and berries of nightshade are sometimes eaten, and pigeon-grass and smartweed are frequently consumed in large quantities. The amount of grain food in the stomachs thus far examined is surprisingly small, while the proportion of weed seed is astonishingly large, in some cases

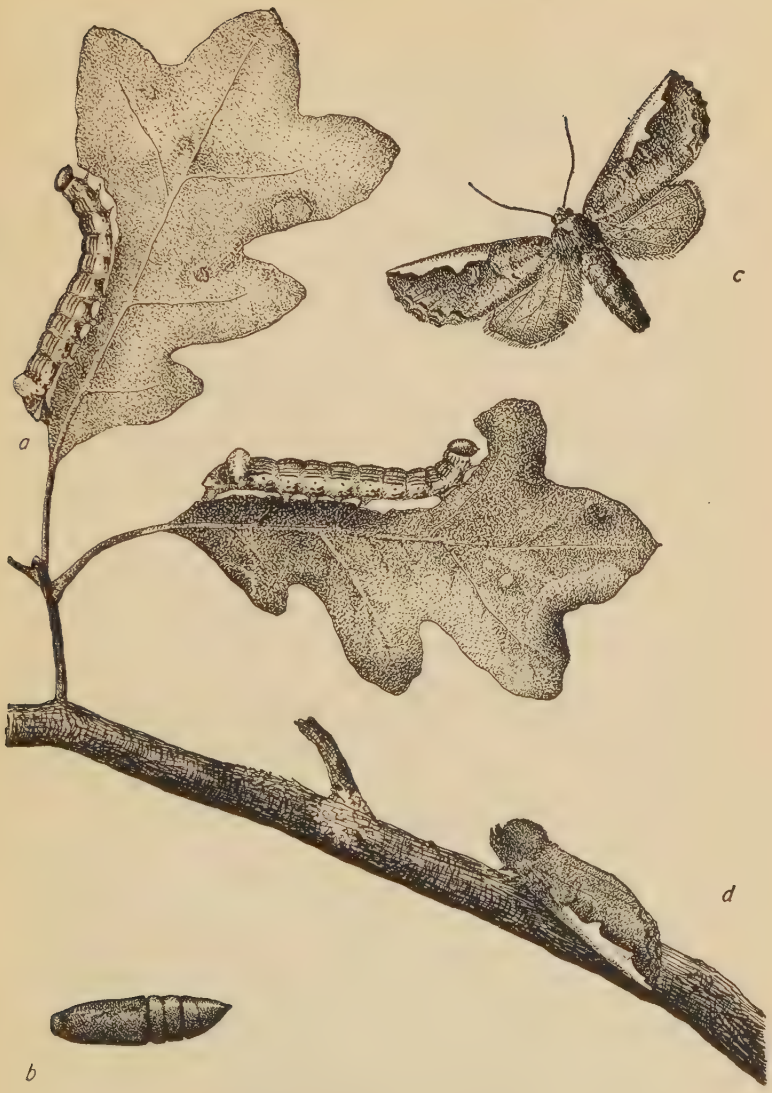
crops and gizzards being literally gorged with hundreds of seeds of ragweed."[1]

The Ruffed Grouse as a game-bird ranks higher in popular esteem in the East than any other bird. The flesh is white and delicious, and its wariness and rapid flight exact the best efforts of even the most experienced sportsman. Its food habits are of secondary importance, but nevertheless interesting. The following, from the pen of Dr. A. K. Fisher, of the Department of Agriculture, Washington, bears directly on this point.

THE RUFFED GROUSE.

"The ruffed grouse is very fond of grasshoppers and crickets as an article of diet, and when these insects are abundant it is rare to find a stomach or crop that does not contain their remains. One specimen, shot late in October, had the crop and stomach distended with the larvæ of *Edema albifrons*, a caterpillar which feeds extensively on the leaves of the maple. It is called the red-humped oak-caterpillar.

[1] Judd, Yearbook, Dept. Ag., 1898, p. 231.



THE RED-HUMPED OAK-CATERPILLAR.

a, larva ; *b*, pupa ; *c*, moth, wings expanded ; *d*, moth at rest.

Beechnuts, chestnuts, and acorns of the chestnut and white oaks are also common articles of food. Among berries early in the season the blackberries, blueberries, raspberries, and elder-berries are eaten with relish, while later in the year wintergreen, partridge-berry, with their foliage, sumach-berries (including those of the poisonous species), cranberries, black alder, dogwood, nanny-berries, and wild grapes form their chief diet. In the fall the foliage of plants often forms a large part of their food, that of clover, strawberry, buttercup, wintergreen, and partridge-berry predominating. In the winter these birds feed on the buds of trees, preferring those of the apple-tree, ironwood, black and white birch, and poplar."

In isolated cases ruffed grouse cause some damage to fruit-trees by eating the buds in winter. The extent of the injury which a grouse is capable of doing in a season may be estimated from the contents of a crop examined by us. It was taken from a female shot in January, and contained three hundred and forty-seven apple-tree buds, eighty-eight maple buds, and twelve leaves of sheep-laurel. This was, of course, a single meal, and, as two such meals are eaten per day, it must be reckoned as half the daily consumption.

One of the crops of four birds killed during the latter part of September and subjected to the same scrutiny showed barberries five per cent., sumac seeds twenty per cent., and apple pulp twenty per cent. Another contained ten per cent. of mushrooms and ninety per cent. of red-humped oak-caterpillars (*Edema albifrons*). The other two were shot from the same flock at the same time. Their crops were packed with the oak caterpillars above mentioned and white-oak acorns, the ratios being sixty per cent. and seventy-seven per cent. of caterpillars against forty per cent. and twenty-three per cent. of acorns respectively.

The Prairie-Hen is of more importance than any other member of the grouse family. It is abundant in the prairie region drained by the Mississippi, and furnishes regular occu-

pation for a multitude of gunners. Markets east and west are supplied with great numbers of these birds.

The food of this species seems to be not materially different from that of other grouse in temperate latitudes. Insects form the major portion of the diet in summer. It is fond of grasshoppers and lives on them almost exclusively when they are sufficiently abundant.

In autumn and winter it is usually found in the grain-fields feeding on cereals as well as seeds and berries. In the northern portion of its range the females usually migrate southward to escape the rigors of winter, leaving the stronger males on the home ground.

The Columbian Sharp-tailed Grouse, which ranges over the Great Plains and from northern California to Alaska, ranks among the highest as a game-bird and its flesh is unexcelled for the table. It feeds on berries, among which may be mentioned the snow-berry, bear-berry, whortleberry, and haws of the wild rose, seeds, grains, and insects.

The Dusky Grouse and its closely allied races, the Sooty Grouse and Richardson's Grouse, which together extend through the Rocky Mountains and westward to the Pacific, are perhaps the finest of our grouse. The dusky grouse is large, weighing about three pounds, and during the greater part of the year its flesh has a resinous flavor much relished by those accustomed to it. Except for a little while in summer, when it descends to the ground to feed on berries and seeds, it lives mainly in the pines and firs, the leaves of which constitute its main food.

Of all our game-birds none are so handsome as the several species of plumed partridges found west of the Rocky Mountains. The Mountain Partridge, found along the Pacific coast from San Francisco to Washington, and the California Partridge, with two races representing it in the southwestern part of the United States, have an economic value, both as to food habits and table qualities, similar to the eastern bob-

white. They may readily be kept in confinement and are therefore well adapted for stocking preserves wherever the environment is suitable.

THE PLOVERS.

The plovers are generally distinguished by their bills, which are of only medium length and are constricted between the base and tip; most of the birds lack a hind toe. Economically they stand with the rest of the shore-birds. Of the half-dozen species found in our territory, we will consider the three most important,—namely, the ring-neck plover, the killdeer, and the golden plover.

The Ring-neck Plover is a diffused species, abundant during the seasons of migration, especially along the beaches. Though numbers of them are shot, the bit they furnish seems hardly worth the ammunition. They are of more value living, as eleven stomachs examined by Professor Aughey testify: in each were from fifty-three to sixty insects, more than half being locusts.

In many parts of the United States the Killdeer, or the Killdeer Plover, is one of the most familiar country birds. It is a summer resident in most of the Northern States. It commonly occurs in upland pastures, as well as along the margins of shallow ponds or the beaches of lakes or the ocean. It winters in the South: in Florida we have seen these birds abundant during January, in small flocks spending most of their time along the shores of the numerous ponds and lakes of that State. The major portion of the food consists of insects; angle-worms, crayfish, and similar creatures making up the remainder. In the stomachs of thirteen specimens examined by King there were found ants, grasshoppers and crickets and their eggs, caterpillars, moths, wire-worms, curculios, plant-beetles, a crane-fly, and angle-worms. "The food-habits and haunts of the killdeer are such as to bind it closely in economic relation with that all too small

Photographed from life by Dr. R. W. Shufeldt.

MOUNTAIN PARTRIDGE. ADULT MALE.

band of birds which like the meadow-lark frequent the open cultivated fields. On account of this relationship the killdeer plover should be stricken from the list of 'game-birds,' and encouraged to breed in greater abundance in cultivated fields and meadows." Many years ago a writer in the *Southern Planter* stated that the Southern farmers erroneously thought that the killdeer destroyed young turnips. "I have several times dissected the gizzards of killdeers," he writes, "to show their destroyers that they contain no vegetable substance, and nothing, indeed, but the little bug so famous for destroying young turnips and tobacco plants. These little hopping beetles are a great nuisance in the land, and seem to be rapidly increasing. The killdeers are their natural enemies, and formerly collected in large numbers to fulfil the purposes of their mission."[1]

The Golden Plover breeds in the Arctic regions, but in the migration season it is very abundant and is highly esteemed as a game-bird. It feeds on grasshoppers and other insects, worms, and berries.

THE SNIPES.

In the snipe family are many birds highly valued as game-birds, and some that are useful as insect destroyers. At the head of the list stands the American Woodcock, a familiar game-bird in the Eastern States and occurring as far west as Nebraska. Few birds have so many good points as this: it is pre-eminently a game-bird in every sense of the term, demanding all the skill of the hunter and being unexcelled in the quality of its flesh.

It is one of the earliest arrivals in spring and the return flight is not completed until late in autumn. In spring and early summer it lives in swampy places, probing the black mud with its long bill for worms. In August it flies out to

[1] Quoted by Wilson Flagg, Agr. of Mass., 1861, pt. II. p. 55.

the corn-fields, where it finds an abundance of worms, grasshoppers, and otheir insects, the shade of the tall corn being quite as agreeable to these birds as the tangles of the swamp. Later they return to the runs, but after the leaves have begun to fall they may often be found on high ground, in hard-wood forests, or among the high shrubbery of neglected pastures. Here they turn over leaves, looking for hidden insects and larvæ that lie underneath. This is in October when the woodcock is at its best. A curious feature of a woodcock's bill, recently discovered, is that it is able to bend its upper mandible upward towards the point, which must aid it in the process of feeling about for worms deep in the soft earth.

"The growing scarcity of woodcock," writes Dr. A. K. Fisher, "is a matter of serious alarm, and one demanding prompt action. It must be remembered that there is far more difficulty in saving it from extinction than in preserving gallinaceous birds, such as quail and grouse. In the case of these birds, with their extraordinary fecundity, it is not difficult to restore a depleted covert; for with the addition of a few imported birds, aided by a short term of protection, they should soon reach their former abundance. With the woodcock, however, the situation is different; for the impracticability of restocking, the nature of the food, the migratory habits, and the small number of young are serious obstacles to successful restoration. Quick and effective measures are needed. In many localities in the North where twenty-five years ago a fair shot with a good dog could secure forty or fifty birds in a day's hunt, it is doubtful if ten per cent. of the former bag could now be obtained. During the past autumn (1901) the writer visited hundreds of acres of good woodcock ground in northern New York without flushing a bird or seeing any considerable signs. Reports as to the scarcity of birds come from numerous points, and even in the most favored localities the decrease within the past twenty years has been fifty to sixty per cent."

Photographed from life by Dr. R. W. Shufeldt.

THE AMERICAN WOODCOCK.

This scarcity is to be attributed chiefly to lack of protection by law in the Southern States, where the species passes the winter, and to the spring and summer shooting in many of the Northern States. It is greatly to be desired that these evils should be remedied before this valuable bird becomes practically extinct.

The American or Wilson's Snipe is similar in its make-up to the woodcock, but it chooses different abodes. This snipe is found in open wet places, in meadows, or on sedgy banks, where it can force its long, sensitive bill into the soft turf. Besides the worms taken in this way, it also catches many grasshoppers and other insects found upon the surface. Eight out of eleven stomachs opened by Professor Aughey contained from thirty-eight to sixty locusts each, besides other insects. The toothsomeness of the snipe is equal to that of the woodcock, though its size is somewhat less.

The Gray Snipe, or Dowitcher, is similar to the last, except that it is chiefly confined to the coast and consequently destroys few noxious insects, though it is quite as much a favorite with the gunner.

The Marbled Godwit is one of the largest of the shore-birds; it is known on the Atlantic coast only in the South, but is widely diffused in the temperate regions of the interior. During the breeding season it is often found on the prairies some distance from water. Its diet is purely insectivorous. Richardson tells us that on Saskatchewan plains it frequents marshes and bogs, walking on the swamp moss, and thrusting down its long bill to the nostrils in quest of worms and leeches.

The Hudsonian Godwit is somewhat smaller than the last, and, though more widely distributed, is far less common.

The Willet occurs as a summer resident throughout the country, though more commonly coastwise. It is a large, noisy species, not different in its food habits from shore-birds in general. It follows marshes, often annoying hunters by its

shrill notes of alarm. Other birds have learned to take warning when the willet cries, and leave a dangerous neighborhood. The name tattler has been applied to it and to others of its class. In spite of all their acuteness, willets often fall victims to the huntsman, large numbers of them being shot every season.

The GREATER YELLOW-LEGS is another tattler much sought in the marshes. It is chiefly a migrant through the country at large, noisy and restless like the willet.

The UPLAND SAND-PIPER, commonly called the UPLAND PLOVER, is something of an anomaly, being fitted out with a wader's bill and legs, yet avoiding the water. It is common from the Rocky Mountains eastward, breeding on the prairies of the Western States and on high grass-land in the East. It feeds on beetles, grasshoppers, and other insects, and is a continual benefit while it stays. Aughey states that in Nebraska in locust years "the bulk of the food of this species consisted of locusts." Rev. J. H. Langille relates that this sand-piper sometimes devours cantharides; its flesh then becomes a violent emetic. It holds a high place as a game-bird and is unsurpassed for the table.

THE CURLEWS.

The curlews are distinguished from the other snipes by their size and long decurved bills. Of the three species found in our limits, the LONG-BILLED CURLEW, or SICKLE-BILL, is the largest and most abundant. Its habitat is the whole of North America. It breeds throughout its range, but most abundantly along the Atlantic coast and on the prairies of the Northwest. These birds are generally found near the water, feeding upon the various forms of animal life common to the shore. In summer they devour many grasshoppers and kindred insects. Of ten stomachs examined by Aughey, eight had from fifty-one to seventy locusts, besides seeds and other insects; the other two had from fifty-three to sixty-one other insects and from fifteen to twenty seeds. Wilson tells us that in the fall they

frequent uplands in search of bramble-berries, upon which they get very fat.

The Hudsonian and Eskimo Curlews are migrants only, breeding in high latitudes and mostly passing beyond our southern boundaries in winter. Their food habits are quite similar to those of the sickle-bill. All eat more or less seeds and berries, differing in this respect from the majority of sand-pipers. All are excellent for food.

There is quite a list of small sand-pipers which are very similar to each other in economic value. Their diet consists chiefly of aquatic insects, worms, and small mollusks. Their open habits do not commend them to sportsmen and they are too small to be of much consequence as food. The pot-hunter, however, destroys numbers of them each season along the beaches, preferring thus to earn a few pennies by a slaughter of the innocents and to gratify a lust for murder rather than to turn his hand to honorable labor

THE PHALAROPES.

The phalaropes are a family of small sand-piper-like birds, having lobed toes and thick under feathers which enable them to swim. They are usually seen floating lightly about upon the water, catching flies in the air or gathering larvæ from the water; on shore they take worms and various aquatic forms found there. The best-known representative of the family is Wilson's Phalarope, which is abundant in the Mississippi Valley and westward, though rarely occurring east of Illinois.

Two other species, the Red and Northern Phalaropes, appear in limited numbers during migration, but they are of comparatively little importance.

THE RAILS.

The rails are narrow-bodied birds of medium size which live in reedy marshes. They are much sought by sportsmen and are considered very good birds for the table. They are very

shy and hard to flush, depending for safety more upon their legs than upon their wings. They fly awkwardly and with seeming difficulty, a puzzling matter when the extent of their migration is considered.

The members of the genus Rallus, comprising the Clapper, King, and Virginia Rails, have bills longer than the head, and feed chiefly upon grasshoppers, snails, slugs, small crabs, aquatic insects, and occasionally a few seeds. The clapper rail frequents salt-marshes as far north as Massachusetts.

HEAD OF CLAPPER RAIL.

The rails are found from Texas to Kansas and eastward, though in the East not usually north of the Middle States. Seven stomachs of king rails taken at different times between May and October and opened by Aughey each contained from seventeen to forty-eight locusts and from fourteen to forty-nine other insects, besides a few seeds. The Virginia rail is the most common rail in the Eastern States as far north as New England.

Members of the genus Porzana, including the Carolina Rail, the Black Rail, and the Yellow Crake, have rather

thick bills, shorter than the head, and feed more on vegetable matter. The only one of the group common enough to be of any special importance is the Carolina rail. Thousands of the latter are killed annually in the Atlantic States for market. They feed largely on seeds in the fall, when they become fat and are excellent eating. They are a diffused species, breeding from the Middle States northward.

THE GALLINULES, COOT, AND CRANES.

The gallinules resemble the rails in their habits and appearance; they are larger than most rails, however, and are distinguished by a horny plate, or shield, which extends from the bill upward over the forehead. Their food is not noticeably different from that of the genus Porzana of the rails. The Purple Gallinule is a resident of the South Atlantic and Gulf States. The Florida Gallinule is found throughout the warmer portions of the country, frequently reaching New England. Both are called mud-hens by gunners.

The term mud-hen is also applied to the Coot, which is allied to the gallinules, having the same outline and frontal shield. It is peculiar in having lobate toes, which enable it to swim easily. Most of its time is spent on the water along marshy shores, where it finds shelter among the tall grass and reeds. Its food consists of insects, aquatic plants, and small mollusks. Its flesh is frequently eaten, though generally it is not highly esteemed.

The cranes are large waders resembling the herons in outward appearance, but differing from them in structure and habits. The Whooping Crane is chiefly a migrant, moving up and down the Mississippi Valley with the changing seasons; it is an omnivorous feeder. Audubon found these birds in November tearing up lily-roots from the bottom of a dry pond. Again in the same month he says, "They resort to fields, and feed on grain and peas and dig up potatoes, which they devour with remarkable greediness." In April they had left the fields

and removed to the swamps and lakes, where they caught frogs, lizards, snakes, and young alligators. He saw one catch and swallow a butterfly, and from the stomach of another he took a fifteen-inch garter-snake. Wilson credits them with eating mice, moles, and rats.

The Sand-hill Crane is common in the South and West, being a more southerly species than the whooping crane. Four stomachs of this crane examined by Aughey showed from thirty-seven to eighty locusts and from thirty-six to seventy-eight other insects in each, besides more or less seeds. Both species are edible, but they should not be sacrificed for this purpose.

THE HERONS, IBISES, AND STORKS.

The herons are waders, with sharp, spear-like bills, that frequent shores and marshes, feeding on any sort of animals small enough to be swallowed that may come in their way. Their flesh has a fishy taste which renders it unpalatable to most people. Taxonomists separate the ibises and storks from the herons proper, but, as they all have the same economic value, it will best serve our purpose to consider them under the same heading.

The White Ibis is an abundant resident of Florida, common throughout the South Atlantic and Gulf States and northward to Ohio. It feeds upon crabs, crawfish, snails, and the like. Audubon relates that when the crawfish burrows deeply to find water in dry seasons, this ibis crushes the mound raised about the burrow; some of the dirt falls down upon the crawfish, which hastens to the surface to throw it out again, when the crafty bird quickly plucks him from his hiding-place.

The Wood Stork, better known as the Wood Ibis, is a large, gregarious wader, usually found in the thickly-wooded swamps of the Southern States. It devours fish, snakes, frogs, young alligators, crabs, rats, and young birds. It is related to the famous white stork of Europe.

The Bittern, or Stake-driver, is common throughout the country. It is a solitary bird, inhabiting weedy marshes, but known by its peculiar cry. During the day it hides among the tall grass and reeds, picking up a grasshopper or a beetle, or perchance a young mouse now and then. Towards evening it seeks the water and partakes of its regular meal, which consists principally of small frogs and fish.

The Great Blue Heron, the largest of its tribe in America, is well known in all quarters. Its tall and awkward form is often seen on the borders of ponds and streams, when it moves with a stealthy tread, on a combined watch for food and enemies. It lives principally upon fish and frogs, but readily devours grasshoppers, dragon-flies, water-boatmen, seeds, and even meadow-mice. Small pickerel, which like to bask in the sunshine in shallow water, are destroyed in great numbers by this heron.

The Green Heron is another widely diffused species. It is the common small heron found beside brooks and in muddy places at or near water margins. Being small, its diet is restricted to worms, insects and their larvæ, tadpoles, small fish, and frogs.

The Great White Egret is found in the Southern States, but in much smaller numbers than formerly. This egret, in common with several smaller species, has for years been the object of unremitting persecution by plume-hunters. As the coveted plumes appear only at the nuptial season, they are easily procured by visiting the heronries when the egrets assemble in great numbers to breed. One man has been known to kill several hundred old birds in a day, leaving the young to starve and the dead bodies to rot after a few choice feathers have been plucked. Egret-plumes are worn by certain dressy organized bodies of men, military and otherwise, and by ladies. Much has been said and written of late against wearing feathers of wild birds, and it is to be hoped that the tide of popular sentiment may be turned against the practice before such

unfortunately beautiful birds as the egrets shall have been exterminated.

Although there are a number of herons that have not been mentioned, a complete enumeration would add nothing to what has already been said concerning the relations of herons to the welfare of man. While the direct economic value of these graceful and beautiful birds may not be very great, they add a charm to the scenery of lakes and ponds, the value of which is not likely to be over-estimated even by those keenly alive to the beauties of nature. It is a pity so many thoughtless people consider such birds legitimate prey for gun and rifle. They deserve the fullest protection of the law and the good-will of all intelligent people.

CHAPTER XX.

THE WATER-BIRDS.

THE DUCKS, GEESE, AND SWANS.

The members of this group are omnivorous birds, eating animals and vegetables in varying ratios, as may be readily guessed by any one familiar with domestic varieties. Their economic status, however, does not depend so much upon what they eat as upon the quality of their flesh. Their feathers have a value, to be sure, but that is a secondary consideration, which is pretty nearly constant throughout, while the great variation in ducks and geese from a gastronomic standpoint is worthy of particular attention.

The Mallard Duck is an abundant species, except in New England, where it is rather rare, being replaced by the black or dusky variety. The common greenheaded domestic duck is of mallard stock, though probably introduced from Europe, where the mallard is a common wild species. During autumn the mallards come into the United States in great numbers—the majority breeding beyond our northern limits—and are much sought by sportsmen. They weigh from two to three pounds each.

The Black Duck, or Dusky Duck, is a favorite in the Eastern States, where it is abundant, breeding in New England and northward. It is nearly related to the mallard, which it equals in size and quality. The Teals, blue-winged and green-winged, are two small ducks well known through the country, except in New England, where they are not so common as elsewhere. Being little, they are of less importance than the preceding, though they are quite as good for eating. Other ducks of equal rank with those already mentioned are the gadwall, widgeon, shoveller, pintail, and wood-duck. All are

inland birds, feeding upon insects, mollusks, nuts, grass, and grain. In the West they visit the vast grain-fields in harvest-time and soon get in excellent condition for the table.

"The Wood-Duck, or Summer Duck," writes Dr. A. K. Fisher, "is the most beautiful of all the members of the large and diver-

HEAD OF DUSKY DUCK.

sified duck family, and, on account of its beauty and lack of shyness, is one of the best-known species in the country. It is not seclusive, often making its abode near towns, or perhaps in the vicinity of farm-houses, where it may be found feeding or associating with barn-yard ducks. It takes kindly to domestication, and is easily tamed and induced to breed in captivity. Its favorite haunts are small lakes, weedy ponds, or shady streams in the midst of, or in close proximity to, scattered woodlands, and, except during migration, it is rarely met with about open bays or large bodies of water."

This beautiful bird seems in danger of extermination, an event to be deplored by every lover of Nature. Special effort should be made to protect it in its nesting sites and to prevent its being shot during the spring season.

Our most popular duck is undoubtedly the CANVAS-BACK, famed among epicures for its delicate flavor, resembling that of celery. This is due to feeding on a water-plant known as wild celery (*Vallisneria*), and is not acquired till the birds get to the Chesapeake region, where the plants grow abundantly. Canvas-backs from Chesapeake Bay bring a much higher price

HEAD OF OLD SQUAW DUCK.

than those from other localities. Except for its peculiar appetite in the one instance of wild celery, the canvas-back's menu shows no appreciable difference from that of the group just treated of.

An associate and relative of the canvas-back is the RED-HEAD, another excellent table bird. In both size and color there is such a strong resemblance between the two that dishonest market-men have been known to impose on customers, not well informed in ornithological matters, by selling red-heads for canvas-back. The RING-NECK and the GREATER and LESSER

Scaups belong to the same genus as the canvas-backs and red-heads, but they feed more on mollusks and other forms of animal life and are less palatable.

The Whistler, or Golden-eye, Old Squaw, Butter-ball, or Dipper, and Ruddy Duck are all easy divers, which feed chiefly on mollusks and similar creatures that they obtain from the bottoms of ponds and lakes. They are often eaten, but possess a fishy flavor that is not relished by most people.

Of the more distinctively sea-ducks, only the surf-ducks and eiders need be mentioned. Surf-ducks or Scoters of various species are abundant along the coast from autumn till spring.

HEAD OF SURF SCOTER DUCK.

Many of them are killed every year, but they are of inferior quality, having a rank taste that comes from a diet of shell-fish. The American Eider and King Eider are both arctic species that rarely come further south than New England. They, in common with other varieties of eiders, furnish eider-down. This down is in great demand in northern European countries for filling coverlets. The best, known as live down, is that plucked by the duck from her breast to line her nest, and afterwards abstracted by the down-gatherer. Greenland, Iceland, and Norway are the chief sources of eider-down. The following quotation from Newton's "Dictionary of Birds" tells

how the down is obtained in Iceland and Norway, and incidentally carries an impressive lesson concerning what may be accomplished by the kindly treatment of wild birds. "This bird generally frequents low rocky islets near the coast, and in Iceland and Norway has long been afforded every encouragement and protection, a fine being inflicted for killing it during the breeding season, or even for firing a gun near its haunts, while artificial nesting-places are in many localities contrived for its further accommodation. From the care thus taken of it in those countries it has become exceedingly tame at its chief resorts, which are strictly regarded as property, and the taking of eggs or down from them except by authorized persons is severely punished by law. . . . The nest is generally in some convenient corner among large stones, hollowed in the soil, and furnished with a few bits of dry grass, sea-weed, or heather. By the time that the full number of eggs (which rarely if ever exceeds five) is laid, the down is added. Generally the eggs and down are taken at intervals of a few days by the owners of the eider-fold, and the birds are thus kept depositing both during the whole season; but some experience is needed to insure the greatest profit from each commodity. Every duck is ultimately allowed to hatch an egg or two to keep up the stock, and the down of the last nest is gathered after the birds have left the nest."

The Fish-ducks, or Mergansers, are characterized by denticulate mandibles, which have given them the name of saw-bills. They are expert divers, living chiefly upon fish. We have three species, two of which are commonly called sheldrakes. The largest, to which the books give the name of goosander, spends the winter as far north as possible, usually in the larger rivers which have a current swift enough to defy frost. They closely follow the ice as it retreats northward in spring, and April finds them at their summer homes. The red-breasted merganser is the sheldrake that reaches the New England coast about the first of May. It is more com-

mon than the goosander, particularly near the sea. Both of these mergansers are good-sized birds, weighing from three to four pounds, but they are ill-flavored and not generally relished as food. The hooded merganser is a handsome little duck, bearing a high, fan-like crest the whole length of its head. It shows a fondness for small streams and ponds, and eats more or less insects, though small fish, tadpoles, etc., make up the major part of its food.

The American White-fronted Goose, best known towards the Pacific coast, differs little from the European white-fronted species, of which the ordinary tame goose is a descendant. Its habits and qualities are similar to those of the domestic bird. Two other species of equal worth are the Snow-Goose, common in the interior, and the Canada or Wild Goose. Canada geese have been crossed with the domestic breed with good results, the hybrid being considered more hardy than the common stock. The Brant-Goose is a maritime variety, more abundant on the Atlantic coast than elsewhere, though it is sometimes found inland. It feeds on shell-fish and other marine products, both animal and vegetable. Its flesh is not much esteemed.

The swans do not differ materially from geese, either in food or flesh. They are wary creatures, rare in the East and nowhere abundant, breeding in high latitudes and appearing in the United States only during the winter.

The Trumpeter Swan is found from the Mississippi Valley westward, while the other species, the Whistling Swan, reaches the Atlantic coast as far north as New Jersey. Of the two kinds of swans seen in captivity, the white one comes from England, where it has lived in royal favor for centuries, and the black variety is brought from Australia, where it still exists in a wild state.

THE GANNETS.

The gannets are large marine birds, goose-like in size and contour, which as they fly seek their finny victims and take them

by a headlong plunge into the water quite out of sight. They feed entirely on fish,—herring and mackerel being preferred.

White Gannet are found on both sides of the Atlantic. On the American side they breed on Gannet Rock, in the Gulf of St. Lawrence, and at one or two other places in that region. Like other gregarious sea-fowl, they suffer much at the hands of the fishermen and are rapidly decreasing in numbers. After the breeding season they follow the open sea in quest of their favorite quarry, and often guide the fishermen to an abundance of herring and mackerel. Their manner of fishing is as methodical as the evolutions of a military company. They fly in single file, and as each individual comes over a shoal of fish he closes his wings and dashes down with unerring aim into the waves, to appear again in a moment and take his place in line.

Along the south Atlantic and Gulf coast is found the Brown Gannet, better known among sailors as the "booby," so named because it has in many instances been so foolish as to alight on ships at sea and allow itself to be caught by the hand. The booby's habits do not materially differ from those of the white gannet. A South American species known only along the coast of Peru contributes to the guano supply.

THE DARTER.

The Darter, or Snake-Bird, is a native of the Southern States, ranging in summer as far north as the Carolinas and Illinois. Its appearance is that of a duck with rather long fan-shaped tail, extremely long slender neck, small head, and long pointed bill. It is an expert diver, having a curious faculty of being able to swim at any degree of submergence, from high floating to such a depth that only the head remains in sight, when its apparent snakiness is startling. It feeds on a great variety of fish, frogs, lizards, crawfish, leeches, shrimps, young alligators, snakes, terrapin, which it can overtake under water like a true diver. It is a shy, watchful bird, living in secluded swamps.

THE CORMORANTS AND PELICANS.

The CORMORANTS are large birds, principally maritime yet often straying into the interior, which are represented by different species in every temperate quarter of the globe. They are proverbial fishers. In China they are domesticated and trained to fish for their masters, being prevented from swallowing their game by a close-fitting ring put about their necks. The common cormorant is found along the Atlantic coast down to the Middle States in winter. The double-crested cormorant is the only one diffused throughout the country. The Mexican cormorant is a tropical species that occasionally makes its way up the Mississippi Valley. They all agree in living exclusively upon fish, and, as they are not sufficiently abundant to interfere with human interests in that line, may be regarded as of no economic account in this country.

The pelicans are large, cumbersome birds, remarkable for a capacious pouch of extensible skin between their lower jaws. They are common in temperate regions, feeding mostly on fish and other animals, yet not averse to insects. The WHITE PELICAN is common in the Southern States, ranging well up the Mississippi Valley. It feeds by scooping up its prey as it swims on the water, letting the water run out at the sides of its mouth, and swallowing the luckless creatures left within. It walks readily and is able to pick up more or less food on shore. Five Nebraska birds that came into the hands of Aughey had fed as follows: One had eaten a frog; all had eaten fish, crawfish, and insects. None had taken less than twenty-one insects. Forty-one locusts were found in one stomach and forty-seven in another. A stomach opened by Audubon was found to contain about a hundred small worms.

The BROWN PELICAN, a more southerly bird, confined to the coast, feeds wholly on fish taken at a flying plunge, after the manner of a gannet.

THE FRIGATE BIRD AND THE GULLS.

The FRIGATE BIRD, or MAN-OF-WAR BIRD, is a maritime species, having its four toes webbed together; it resembles in this particular the gannets, darters, cormorants, and pelicans; indeed, it has a double relationship to the pelicans, by reason of its gular sac or pouch. Having a comparatively small body, with extremely long pointed wings and a long forked tail, its powers of flight are astonishing. Frigates fish for themselves when necessity demands it, but they much prefer robbing gulls and terns of their well-earned sustenance by forcing them to disgorge. They are found on the south Atlantic and Gulf coasts.

The gulls are long-winged, web-footed birds, well equipped for both aerial and aquatic navigation. Most of them are winter visitors along the coast, though many frequent the great lakes and other inland waters. Fishermen watch their movements and are often led to good luck by them. The Manx government protects them because of their usefulness as an index of mackerel schools. Gulls have moderately long bills, somewhat hooked at the tip, suitable for taking animal food. Their diet, however, varies considerably in different species, and, even in the same species, more or less according to the situation and relative abundance of eatables.

The GREAT BLACK-BACKED GULL, one of the largest of its kind, belongs to the class which chooses to live on meat and fish. Audubon states that it devours all sorts of food except vegetables, even the most putrid carrion, but prefers fresh fish, young birds, small quadrupeds, or eggs. A specimen examined by Professor Aughey had eaten a few grasshoppers and other insects, but mostly fish and frogs. The HERRING GULL, a much commoner species, that is found both coastwise and interiorly, has similar good habits. A stomach examined by Dr. Coues contained the remains of a marsh-hare. Two which were examined by Professor Aughey had grasshoppers, fish, and mollusks. One shot by us had eaten only refuse of

an oily consistency. This gull breeds from New England and the great lakes northward. Their eggs, like those of the guillemot, are taken in great quantities, and young birds are salted and laid in store by dwellers in the far North, although in a land where food is plentiful gull flesh is not relished. The Kittiwake Gull, so far as food habits go, may be classed with those already mentioned. It is a winter visitor, known as far south as the Middle States, chiefly along the coast. Other species range more or less over marshes and high grounds and take a larger proportion of insects. One of these is the Ring-billed Gull, a common species the land over. Those found in the interior consume many insects. One stomach opened by Professor Aughey contained forty locusts; four others had from ten to thirty-three insects each. All had partaken of fish, crawfish, or mollusks.

Bonaparte's Rosy Gull is another common gull interiorly and coastwise, being especially abundant along the Atlantic coast during migration. It is often seen coursing over stubble and ploughed land. Two stomachs opened by Nuttall were gorged with ants, ants' cocoons, and moth pupæ. Franklin's Rosy Gull moves quite across the United States in its migrations, its main route lying west of the Mississippi River. Of ten stomachs examined by Aughey, six had from thirteen to fifty-three locusts each, besides a few other insects and remains of fish and frogs; the rest had from twelve to thirty-nine other insects, together with mollusks, snails, fish, crawfish, and lizards.

THE TERNS AND JAEGERS.

The Terns resemble the gulls in form and habits, though they are readily distinguished by their smaller size, their buoyant airy flight, and sharply pointed bills. Among those that are most often found away from salt water, and consequently the only ones whose food relations especially interest us in this connection, are the least tern, Forster's tern, the gull-billed or marsh tern, and the black tern. The

least tern is hardly longer than a swallow. It feeds with equal readiness on insects and aquatic animals; beetles, crickets, grasshoppers, and spiders are all set down as forming part of its diet. Four stomachs out of eight examined by Professor Aughey contained from twenty-three to forty-nine locusts each. The others had from four to forty-nine other insects and remnants of fish, lizards, and crawfish. The three other species have like records. Several gull-billed terns killed by Wilson had eaten nothing but large aquatic spiders. Professor Aughey's examination of six black terns revealed from forty-seven to eighty-four locusts each in four, and from twenty-eight to fifty-nine insects in the other two. There was the usual complement of water animals in each. Among the more maritime terns are the royal, sandwich, caspian, roseate, and sooty terns, and the noddies. These feed almost wholly on small fish and mollusks.

The more delicately tinted terns have been subjected to an outrageous slaughter for their skins for millinery use, to gratify a lingering taint of savagery in woman, a desire to adorn herself with feathers,—*a la primitif*. Wholesome legislation and a more enlightened public opinion, however, are slowly coming to the rescue of the disappearing birds.

The Black Skimmer is a peculiar tern-like bird, which has its lower mandible about an inch longer than the upper. Its food consists of shell-fish, shrimps, small crabs, sand-fleas, etc., which are plowed from the water by the knife-like lower mandible as the bird skims along with lowered head just above the surface.

The Jaegers form a small family. They resemble gulls in their appearance, and are chiefly maritime, though sometimes drifting inland; they are parasites of the smaller terns and gulls. Their favorite method of gaining a livelihood is to pursue a gull or tern and so tire and pester it till it disgorges its last meal, which is quickly devoured by the robber. An inland straggler was found to have eaten fish, frogs, crawfish,

and even a few grasshoppers. They catch their food when they cannot steal it. The four that visit us are the skua gull, the pomarine, parasitic, and long-tailed jaegers. None of them are common.

THE PETRELS AND AUKS.

The Petrels, including fulmars and shearwaters, are pelagic birds, adapted for both flying and swimming, that rarely land except to lay their eggs. They will follow a ship for days together, picking up such bits of food as may be thrown overboard. The stomachs of several specimens of Wilson's petrel, opened by the naturalist for whom they were named, showed barnacles, seeds of gulf-weed, and greasy refuse from vessels. Leach's petrel, a common species off the New England coast and northward, attends fishing-vessels for the sake of the waste from the cleaning tables. Fulmars accompany whalers and feast upon scraps of blubber. All petrels are especially fond of fatty matter.

The Auks are an exclusively marine family of diving birds that feed wholly on animal substances, such as small fish, shrimps, roe, and crustaceans. The puffins, which constitute one branch of this family, exhibit strange nuptial changes in their bills. As the breeding season advances, the bill increases in a vertical direction until it is nearly as deep as the head itself. This increase is caused by the growth of additional flakes, which are shed with the feathers during the moulting season.

The Common Puffin, or Sea Parrot, is the only one to visit our eastern coast. Other auks have seasonal changes of bill, but none of them belong on the Atlantic coast. The Great Auk, which has been extinct for more than fifty years, was formerly killed in great numbers for its flesh and feathers. Its wings were so small that flight was out of the question, and, though able to take pretty good care of itself in the water, when on land it was at the mercy of any foe larger and more

powerful than itself. The early fishermen sought great auks on the barren northern islands in nesting time, slaughtered them right and left with clubs, and salted their flesh. This ruthless destruction could have but one result. Only a few skins, eggs, and bones in museums remain as tangible evidences of this once abundant bird.

Another branch of the auk family, including several species which have been and still are to some extent severely persecuted, comprises the GUILLEMOTS, or egg-birds. In this case it is not the birds themselves so much as their eggs that attract marauders. Each spring the guillemots congregate by thousands on certain rocky islands and shores to deposit their eggs. In such vast numbers do they come that they fairly cover the ground while incubating. The eggs are quite palatable while fresh, but most of them are sold for use in the arts, the albumen they contain being a requisite in several industries, such as the manufacture of patent leather and in clarifying wine. Gathering the eggs of this and other sea-birds was formerly a fixed occupation for a class of rough characters known as eggers, who regularly plied their trade while the season lasted. In order to insure fresh eggs, they would first break every egg on the ground, then come daily afterwards for their harvest. An easy way to smash the eggs, and one often followed, was to roll barrels back and forth over the whole nesting-place. Egging was carried on so persistently that the number of birds became seriously decreased, and our Eastern States as well as the Canadian government have prohibited it.

The following extract from Audubon's "Eggers of Labrador" presents a vivid picture of the people and their business as he saw them there. "The vessel herself is a shabby thing: her sails are patched; her sides are neither painted nor even pitched; no, they are daubed over, plastered and patched with strips of seal-skin along the seams. Her deck has never been washed or sanded; her hold—no cabin has she—though

at present empty sends forth an odor pestilential as a charnel-house. The crew, eight in number, lie sleeping at the foot of their tottering mast, regardless of the repairs needed in every part of her rigging. . . . As I suspect her crew to be bent on the commission of some evil deed, let us follow her to the first harbor. The afternoon is half over. Her crew have thrown their boat overboard; they enter and seat themselves, each with a rusty gun. One of them sculls the skiff towards an island for a century past the breeding-place of myriads of guillemots, which are now to be laid under contribution. At the approach of the vile thieves, clouds of birds rise from the rock and fill the air around, wheeling and screaming over their enemies. Yet thousands remain in an erect posture, each covering its single egg, the hope of both parents. The reports of several muskets loaded with heavy shot are now heard, while several dead and wounded birds fall heavily on the rock or into the water. Instantly all the sitting birds rise and fly off affrighted to their companions above, and hover in dismay over their assassins. . . . See how they crush the chick within its shell, how they trample over every egg in their way with their huge and clumsy boots. Onward they go, and when they leave the isle not an egg that they can find is left entire. The dead birds they collect and carry to their boat. Now they have regained their filthy shallop; they strip the birds by a single jerk of their feathery apparel, while the flesh is yet warm, and throw them on some coals, where in a short time they are broiled. The rum is produced when the guillemots are fit for eating, and after enjoying themselves with this oily fare, and enjoying the pleasure of this beastly intoxication, over they tumble on the deck of their crazed craft, where they pass the short hours of night in turbid slumbers. . . . On Guillemot Isle the birds have again settled and now renew their loves. Startled by the light of day, one of the eggers springs to his feet and arouses his companions. . . . The master, soon recollecting

that so many eggs are worth a dollar or a crown, casts his eye towards the rock, marks the day in his memory, and gives orders to depart. The light breeze enables them to reach another harbor a few miles distant, in which, like the last, lies concealed from the ocean some other rocky isle. Arriving there they reënact the scene of yesterday, crushing every egg they can find. For a week, each night is passed in drunkenness and brawls, until, having reached the last breeding-place on the coast, they return, touch at every isle in succession, shoot as many birds as they may need, collect the fresh eggs, and lay in a cargo."

THE LOONS AND GREBES.

The Loons are large, powerful divers, that are equally at home in fresh and salt water. Owing to their wariness, and also to the fact that they cannot fly without a long course in which to get a good start before leaving the water, they are not usually found in the smaller streams and ponds. Except during the period of incubation they rarely venture ashore. They feed almost wholly upon fish, which they dive for and pursue with great energy. In the economical balance they have little weight either way. The fish they consume are generally worthless, while their own flesh is hardly better. The common loon is a picturesque element in the scenery of our northern lakes in summer. In winter it may be found in the sea or wherever there is plenty of open water. The red-throated loon is a more northerly bird that breeds entirely beyond our limits, but is found fairly common out of breeding season. The black-throated loon is an arctic species rarely appearing in the United States.

The Grebes constitute a branch of the diver family. Their chief peculiarities are wide, flat, unwebbed toes and an entire lack of tail. They are essentially fresh-water birds, designed, like divers in general, to glean a livelihood in the liquid element. Small fish, lizards, tadpoles, and aquatic insects, with

now and then a blade of grass or a few seeds, constitute their usual diet. Inasmuch as they are unable to travel on land with any ease, owing to the rearward position of their legs, only such insects as belong to the water or accidentally fall into it are eaten. Of the four varieties common to the eastern half of the United States, the little DABCHICK, or PIED-BILLED GREBE, is perhaps the best known. Its bill is shorter and thicker than the bills of other kinds, and it may readily be guessed that its food is not so strictly of an animal nature. A single stomach examined by us contained the broken wing-covers of many beetles, a few feathers, evidently from its own breast, and considerable sand. The other three species have spear-like bills and have practically identical food habits. They are the RED-NECKED GREBE, the HORNED GREBE, and the EARED GREBE. The first two are found at large throughout the country. The eared grebe belongs west of the Mississippi River. Of two stomachs of the last named opened by Professor Aughey, of Nebraska, one contained nine locusts, some grass, a few seeds, and the remains of crawfish; while the other had five grasshoppers, a few other insects, fish, and crawfish. None of the grebes are much esteemed as food, being rather coarse and rank-flavored.

Both loons and grebes are levied upon to satisfy the demands of fashion, the breast portions of their skins being prized by milliners.

CHAPTER XXI.

THE CONSERVATION OF BIRDS.

I. NON-GAMEBIRDS—THEIR DESTRUCTION, PROTECTION, AND ENCOURAGEMENT.

According to the latest classification, there are eleven hundred and twenty-four species of birds inhabiting America north of Mexico. They are included in seventeen orders. For our present purpose we will divide them into two classes, —namely, gamebirds and non-gamebirds. The gamebirds, comprising only five orders, amounting to two hundred and twenty-two species, will be considered in the next chapter. The nine hundred and two species and subspecies in the twelve orders of non-gamebirds are of all sizes and of a wide variety of habits. While of little or no use as food, and generally recognized as important aids in keeping insects within supportable limits,—or, in case of birds that prefer other food than insects, either beneficial or at least harmless, —they have too often been slaughtered and otherwise persecuted.

It seems a well-established fact that birds, as a class, are now less numerous in the United States than they were a century or more ago. While some species have doubtless become more abundant under the changed conditions of modern civilization, others are very much rarer, and a few appear to be approaching extinction. It was, of course, inevitable that the changes produced by man's interference with natural conditions should have a tremendous influence upon the native fauna. Some birds have found the new dispensation better suited to their wants than the old; others have changed their habits and made the best of it; while others have been so relentlessly persecuted that their only

hope of survival lay in retreating to inaccessible localities. The wholesale destruction of primeval nesting-sites has been a potent factor in the change produced, but, fortunately, many of the most useful birds found substitutes that answered the purpose very well: kingbirds, chipping-sparrows, cedar-birds, and robins have apparently been glad to adopt the imported apple tree for a home tree; swallows, swifts, and phœbes have left the cliffs and hollow trees they formerly possessed for rafters and chimneys and artificial houses put up for their benefit. Meadow-larks, vesper, savanna, and other "ground" sparrows inhabiting grass-lands have undoubtedly increased in numbers and widened their habitat since mowing fields have so largely superseded timbered areas.

Even under normal conditions birds have to encounter grave perils that many of them, particularly of the smaller varieties, are unable to withstand. Of these their annual migration over hundreds and thousands of miles of land and sea probably is most fatal. Their periods of travel are seasons of strenuous weather. Gales carry them out to sea and leave them exhausted to perish on the waves. Unwonted cold in the South sometimes destroys them in great numbers. A backward spring in the North, by retarding insect development, adds hunger to cold. At the end of the long journey, tired and lean, the birds suffer greatly when spring is late. Warblers, orioles, tanagers, and other sylvan species may be seen searching among the stubble for something to eat. Their feebleness is apparent. Sometimes a cold storm follows, and when such is the case many invariably die. It is interesting to note that during such a stress of weather many birds that ordinarily frequent the woods come to the vicinity of houses. A parula warbler has been known to seek refuge in a store doorway, a humming-bird to crawl into a crevice in a garden gate, and redstarts and a Canadian warbler to find shelter in a barnyard. Birds found dead after such a storm are greatly emaciated, showing plainly the effects of starvation. Well fed,

they could stand the weather, but hunger and cold combined they could not endure.

Young birds are subject to many dangers before reaching maturity. Foxes, cats, skunks, minks, weasels, squirrels, hawks, owls, crows, jays, and snakes are always seeking to devour them. The percentage of young birds preyed upon by predaceous animals is certainly quite large. Heavy rains destroy many more. Adult birds also fall victims to predaceous animals, particularly hawks and owls, though less often than the young.

Light-houses, situated as they are in a main thoroughfare of migration, cause the death of many birds. Most birds fly by night, and, coming into a beam of light, they follow it to their destruction. Telegraph and telephone wires are another danger. Fortunately, many birds that hit them are not killed, so they are able to profit by experience. A western writer has noted that in a certain locality the number killed during the first few years after the wires were put up was much larger than the number killed in later years.

But besides these natural causes and the inevitable results of the white man's occupation of the American continent, certain causes have been, and still are, at work which tend greatly to decrease the number of birds possible under existing conditions. To a large extent these agencies are the result of human greed, cruelty, and ignorance, and the havoc they commit may be avoided by proper laws based upon and supported by the opinion of an enlightened public.

Perhaps one of the most constant and serious of these agencies is the egg-collecting or nest-destroying small boy. In almost every town or village there may be found a dozen or more youths who have frequent attacks of the collecting fever. Unfortunately, the fever is often of the intermittent type, and the season's collections are allowed to go to ruin before the advent of another spring. Every nook and cranny for miles around the head-quarters of such a coterie is examined

by sharp eyes, and the great majority of birds' eggs are gathered in. Probably with ninety-nine boys out of a hundred these egg collections are soon forgotten, while the hundredth boy is too likely to become a mere collector who strives to see how many varieties of eggs he can get together without reference to their natural history values. To this class of collectors we owe the existence of the egg-dealers who collect eggs in large numbers to sell. The latter are the mercenary collectors, while the intermittent types are the aimless ones,—a classification suggested by Col. W. H. M. Duthie, a Scottish ornithologist, who well defines the "true collector" as "a naturalist acquainting himself with birds, their habits, flight, migration, and breeding haunts; his egg-collecting being only one of the means of acquiring knowledge."

Birds' eggs are sometimes collected by children to serve as Easter gifts the following season,—a sacrilege to which attention need scarcely be called to reveal its inappropriateness. Such an Easter present is a sacrifice of innocence rather than a thank-offering.

Unfortunately, the boy of the period does not limit his destructive powers to the gathering of eggs. The recent increase in cheap fire-arms has placed within his reach the means of killing feathered "game" at all seasons of the year. To this fact is due much of the diminution in the number of small birds in the vicinity of towns and cities. Dr. R. W. Shufeldt thinks that the wholesale destruction carried on by the army of unscrupulous small boys "is a reason for bird decrease before which other reasons stand aghast." He reports meeting near Washington, D. C., "one such youngster, and upon examining his game-bag, found it absolutely full of dead bodies of birds which he had killed since starting out in the morning. One item alone consisted of seventy-two ruby and golden-crowned kinglets. The fellow boasted of having slain over one hundred cat-birds that season."

That the small boy is recognized in other countries as a

prime factor in decrease in birds is shown by the recent recommendation of a committee of the British Association for the Advancement of Science that particular pains should be taken to instruct the youth concerning the birds that should be protected.

Enormous numbers of birds are sacrificed annually for millinery purposes. There is an opinion prevalent that the birds worn on women's hats in America are largely derived from the faunas of tropical regions. Some justification of this is found in the impossible colors of all sorts assumed by the plainest songsters when they have passed through the dye-pot of the preparator. But there can be no question that an immense quantity of bird life is annually destroyed in the United States to gratify the caprice of fashion, the birds thus killed being very largely used within our own borders, while many are exported to Paris and other European cities. The evidence on this point is abundantly sufficient; some of it may properly be introduced here, as the subject is one which is greatly in need of more general knowledge on the part of the public.

An editorial article in the *Forest and Stream* a few years ago mentions a dealer who, during a three months' trip to the coast of South Carolina, prepared no less than eleven thousand and eighteen bird-skins. A considerable number of the birds killed were, of course, too much mutilated for preparation, so that the total number of slain would be much greater than the number given. The person referred to states that he handles on an average thirty thousand bird-skins a year, of which the greater part are cut up for millinery purposes. About the same time, according to a writer in the *Baltimore Sun*, a New York milliner visited Cobb's Island, off the coast of Virginia, to get material to fill a foreign order for forty thousand bird-skins. She hired people to kill the birds, for which she paid ten cents apiece. The birds comprised in this wholesale slaughter were mainly gulls and terns, or sea-swallows,

of which large numbers of several species could formerly be found on this island. But now only a few of these graceful birds remain, and the pot-hunters, or rather skin-hunters, have to go some distance to carry on their cruel occupation. If we consider that with each old bird killed—the killing is done mainly in the breeding season, as only adult birds have suitable plumage—many young, unable to care for themselves, die of starvation, this wholesale slaughter appears the more infamous and criminal.

Further south, in Florida and along the Gulf coast, the herons and egrets have been ruthlessly persecuted for their plumage. The heronries, where enormous numbers of these graceful birds formerly bred unmolested, have been largely broken up, and only the shyness of those remaining enables them to survive. In a paper read before the World's Congress of Ornithologists, at Chicago, in 1893, Mr. T. Gilbert Pearson describes a visit to a locality known as Horse Hummock, Florida. In 1888 he found several hundred pairs of little blue, snowy, Louisiana, and black-crowned night-herons at a heronry there. Three years later, when he returned to the spot, silence reigned, and only fragments of nests and bleaching bones were to be seen. Plume-hunters had either killed or driven off the entire community. Concerning another heronry Mr. Pearson writes as follows: "A few miles north of Waldo, in the flat pine region, our party came one day upon a little swamp where we had been told herons bred in numbers. Upon approaching the place the screams of young birds reached our ears. The cause of this soon became apparent by the buzzing of green flies and the heaps of dead herons festering in the sun, the back of each bird raw and bleeding. The smouldering embers of a camp-fire bore witness to the recent presence of the plume-hunter. Under a bunch of grass a dead heron was discovered from whose back the plumes had not been taken. The ground was still moist with its blood, showing that death had not long before taken place.

The dirt had been beaten smooth with its wings; its neck was arched; feathers on its head were raised, and its bill was buried in the blood-clotted feathers of its breast, where a gapping wound showed that a leaden missile struck. It was an awful picture of pain. Sorely wounded, this heron had crawled away and, after enduring hours of agony, had died, the victim of a foolish fashion. Young herons had been left by scores in the nests to perish from exposure and starvation. These little sufferers, too weak to rise, reached their heads over the nests and faintly called for food, which the dead mothers could never bring."

This slaughter of the innocents is by no means confined to our Southern States. During four months seventy thousand bird-skins were supplied to the New York trade by one Long Island village. "On the coast-line of Long Island," wrote Mr. William Dutcher, not long ago, "the slaughter has been carried on to such a degree that, where, a few years since, thousands and thousands of terns were gracefully sailing over the surf-beaten shore and the wind-rippled bays, now one is rarely to be seen." Land-birds of all sorts have also suffered in a similar way, both on Long Island and in adjacent localities in New Jersey. Nor have the interior regions of the United States escaped the visits of the milliner's agent. An Indianapolis taxidermist is on record with the statement that in 1895 there were shipped from that city five thousand bird-skins collected in the Ohio Valley. He adds that "no county in the State is free from the ornithological murderer," and prophesies that birds will soon become very scarce in the State.

These isolated examples can only suggest the enormous number of birds that are sacrificed on the altar of fashion. The universal use of birds for millinery purposes bears sufficient testimony to the fact. Yet it is probable that most women who follow the fashion seldom appreciate the suffering and the economic losses which it involves.

A few years ago the Committee on Bird Protection of the American Ornithologist's Union issued an appeal in which occurs this paragraph:

"So long as the demand continues, the supply will come. Law of itself can be of little, perhaps of no ultimate avail. It may give check, but this tide of destruction it is powerless to stay. The demand will be met; the offenders will find it worth while to dare the law. Only one thing will stop the cruelty,—the disapprobation of fashion. It is our women who hold the great power. Let our women say the word, and hundreds of thousands of birds' lives will be preserved every year. And until woman does use her influence it is vain to hope that this nameless sacrifice will cease until it has worked out its own end and the birds are gone."

The destruction of the smaller birds for food is much greater than is commonly supposed. It is due not so much to the demand created by native white Americans, as by the foreigners in the North and negroes in the South. During the migrations to and from the southern regions, enormous numbers of birds which are commonly considered non-edible are killed for food. In the larger cities hundreds of such victims are displayed daily. Besides the reed-birds, robins, meadow-larks, and blackbirds that one would expect might be found, there occur woodpeckers, thrushes, sparrows, warblers, wax-wings, and vireos. An interesting example has been reported by Mr. Walter E. Bryant in the case of the "reed-birds" of San Francisco markets. For years there have been exposed for sale small California birds, picked, and six of them ranged side by side with a skewer running through them. These are sold as "reed-birds," though, of course, they are not the Eastern bobolink, which does not occur in California. They are most commonly the horned lark (*Otocoris*), but there may often be found on the skewers housefinches, goldfinches, various sparrows (except the English variety), blackbirds, and sand-pipers. Many thousands of birds are thus destroyed

annually. The tendency, as Mr. Bryant says, is steadily "to increase in severity, and it has long since arrived at that stage of importance which should bring it to the notice of the authorities interested in bird protection."

In the South all sorts of small birds appear in the city markets. In a statement concerning the destruction of small birds in the vicinity of New Orleans, Professor Nehrling says: "There is scarcely a hotel in New Orleans where small birds do not form an item on the bill of fare. At certain seasons the robin, wood-thrush, thrasher, olive-backed thrush, hermit-thrush, chewink, flicker, and many of our beautiful sparrows form the bulk of the victims; but cat-birds, cardinals, and almost all small birds, *even swallows*, can be found in the markets."[1]

A few small birds have ranked as game more or less generally. Of these the bobolink is one. Although one of the best-beloved birds in the North, where it is given all the protection accorded to any bird, in the Middle States it is killed in enormous numbers during the autumnal migration. To one familiar with the bobolink's liquid melody and parental devotion such slaughter seems a sacrilege. In the rice-growing regions along the Carolina coast, bobolinks are veritable pests and as such are destroyed. Robins are also killed in the Southern States during the winter. A notorious example of robin slaughter is that of a consignment of twenty-seven hundred in one lot received by a Washington, D. C., dealer in the spring of 1897. During their stay in the South they occupy regular "roosts," where they assemble at nightfall by thousands, and it is at these "roosts" that most of the slaughter is accomplished.

Flickers, meadow-larks, and blackbirds have been quite generally slain the country over, especially by those unable to kill anything bigger; but among true sportsmen they have

[1] See W. T. Hornaday, 2d Ann. Rept. N. Y. Zool. Soc., p. 86, 1898.

been put on the "retired list." Nevada is the only State in which flickers are legally reckoned among game-birds. Larks are so classed in less than half a dozen States. Eventually all birds of this sort, with the exception of bobolinks and blackbirds in certain localities where they are noxious, will be struck from the game list in practice as well as in theory.

The segregating habit of sea-birds at certain breeding places, so advantageous to plume-hunters, is not less so to "eggers," nor less fatal to the birds. Audubon, in his Ornithological Biography, devotes a chapter to "eggers," with whom he came in contact on his Labrador exploration. Their ruthless invasion of the barren islands inhabited by countless murres and gulls, resulting in the loss of every egg that could be discovered, all summer long, evidently aroused the displeasure of the great naturalist.

Even down to a few years ago, when Dominion laws put a stop to it, egging was continued on the islands off New Brunswick and northward. The eggs were brought off by boat-loads and sold for various purposes. Wherever colonies of sea-birds assemble to breed along our Eastern coast, the practice of turning the eggs to commercial use has been in vogue. The eggs of the laughing gull (*Larus atricille*) are an esteemed delicacy in Virginia. The gulls, terns, and herons, which formerly bred in immense numbers along the coasts of Florida and Texas, have been subject to the same blasting influence. An article[1] by Mr. H. W. Elliott gives an idea of the abundance of eggs and the wholesale manner in which they have been gathered in the Pacific. Mr. Elliott states that when he visited Walrus Island, in Behring Sea, in July, 1872, six men loaded a four-ton boat with murre eggs in less than six hours. Concerning egging in California, Dr. T. S. Palmer writes:[2] "A still more striking example of wholesale

[1] The Auk, vol. v. p. 377.

[2] Yearbook, Dept. of Agr. for 1899, p. 271.

egg-collecting, and probably the most important one in the United States, from a financial stand-point, is that of the Farallones. These islands, or rather rocks, situated on the coast of California, thirty miles west of the Golden Gate, are the breeding-grounds of myriads of sea-birds, chiefly western gulls (*Larus occidentalis*) and murres, or California guillemots (*Uria troile Californica*). For nearly fifty years murre eggs were collected here and shipped to San Francisco market, where they found a ready sale at from twelve to twenty cents a dozen, a price only a little less than that of hens' eggs. During the season, which lasted about two months, beginning near the middle of May, the eggs were shipped regularly once or twice a week. The main crop was gathered on South Farallone, the principal island, and mainly from the 'great rookery' at the west end. The birds lay only one egg, which is deposited on the bare rock. When the season opened the men went over the ground and broke all the eggs in sight, so as to avoid taking any that were not perfectly fresh. The ground was then gone over every day, and the eggs were systematically picked up and shipped to market. The business was in the hands of Italians and Greeks, who were also engaged in fishing, and, although a dozen or fifteen 'eggers' were employed on the islands, the number of eggs gathered was simply enormous. It is said that in 1854 more than five hundred thousand eggs were sold in less than two months, and that between 1850 and 1856 three or four millions were taken to San Francisco. . . . Since then the value of the eggs has declined, and the number has fallen off considerably. In 1884 there were gathered three hundred thousand, in 1896 about one hundred and eight thousand, while in 1896 the crop was reduced to a little less than ninety-two thousand."

As a cause of reduction in the number of sea-birds, egging undoubtedly is entitled to first place. Millinery shooting, though equally destructive in operation, was begun at a date

so comparatively recent that, wicked as it admittedly is, it must be given second rank.

For a long time all birds not used for food were ignored by the American people. Before there was a demand for their feathers and skins they were simply let alone. But when game-birds became scarce, and many foreign immigrants, accustomed abroad to eating small birds, had come to our shores, and rampant fashion had set bird plumes among her gods, destruction began. All the serious dangers that beset the birds, at least those of human origin, have been operating only a comparatively short time. Then, again, it is only a few years since the food habits of such birds have been well understood. In view of all this, it is not strange that protective laws were late in making their appearance on our statute-books. Although game-birds were protected by law early in the nineteenth century, it was in 1850 that "small and harmless birds" were given a legal standing. In that year both Connecticut and New Jersey protected most of the common small birds and their eggs by fixing a fine for each bird or egg destroyed. Other States gradually followed suit, but in fourteen years only twelve States and the District of Columbia had adopted such laws. It was not long, however, before bird-slaughter became notorious, and then legislation quickly became general. "Insectivorous and song-birds" was the term often employed in framing these laws; but that term was too loose and narrow. The slaughter of plume-birds led to their protection in Florida and Texas, where it was especially severe, and by degrees they have come to be included in the number protected by many States. Even birds of prey, since it has been found that there are only half a dozen injurious species out of the whole family—or, rather, so much of it as is found in the United States, numbering about ninety—have come in for statutory shelter in several States. There is a deeply-rooted prejudice against them, however, that cannot be overcome in one generation, even by figures; the acts

of the evil few have so blackened the reputation of the whole family, that it is not probable that hawks and owls will be protected generally or specifically in most States for a long time to come. Utah alone grants protection to the whole tribe. Illinois protects all but "chicken-hawks." Rhode Island protects fish-hawks. Three other States have prescribed fines for killing bald eagles. The turkey buzzards (*Cathartes aura*), which prefer carrion to freshly-killed meat, are useful as scavengers and are protected in the District of Columbia and in eight States and Territories. They ought to be protected wherever they occur.

Besides birds of prey there are a number of other birds to which several States have thus far denied protection. Of such are the grain-eating birds,—crows, blackbirds, etc.; those which live upon fish,—loons, auks, mergansers, herons, and kingfishers; and English sparrows. The last-named is the one most generally condemned; only a few States have exempted fish-eating birds from protection, and less than half have announced a prejudice against crows and blackbirds.

Legislation primarily intended for game has in a few instances afforded protection to all birds. Laws prohibiting shooting on Sunday and those requiring gun licenses are of this sort. Speaking of gun licenses, the protection of non-game-birds is the only reason that can be logically urged in their favor. The declaration that game is the property of the State is the foundation of all game legislation. That all citizens of the State have equal right to it must be conceded. A game law establishing a gun license discriminates against the poor sportsman and in favor of the rich one. On the other hand, a gun license requirement would undoubtedly delay the day when precocious youngsters go forth with two-dollar guns until many of them, at least, are old enough to be out of the bird-killing stage.

In the vicinity of some of our larger cities trapping native song-birds to sell as pets has been carried on to such an extent that several States have prohibited it by law, so they

may neither be captured nor kept in captivity. Other States specify what birds may be caged. Whether birds are caged or not, so long as they are not subject to traffic, is a matter of no importance to birds in general. The few taken from the wild state usually prove good missionaries. People that keep a tame bird a year or two are usually friendly to the race thereafter.

Although every State and Territory except Alaska has its bird law, there is a great lack of uniformity among the different States, and many of the laws are very incomplete. Their enforcement is usually left to State or county officials, generally to game wardens or commissioners. Offences that do not come directly to their notice are rarely heard of, for the reason that most persons, even though favorable to bird protection, dislike to report the misdeeds of their neighbors. The utility of birds and the causes and extent of decrease among them are so little understood by the general public that there is no popular interest either in making or enforcing laws for their preservation. So far as law-making is concerned, it is easy as compared with the task of preventing law-breaking; but even law-making—adequate law-making—has proved uphill work. Protection should be uniform, because most of our birds cover vast areas. Federal legislation, excepting that of an indirect character, like the Lacey Act, which will be noticed in the next chapter, would be unconstitutional, and is therefore impossible, though it would meet the requirements more quickly and effectively than State laws. To meet the need of uniformity, and at the same time to suggest a safe, intelligent measure, the Committee on Bird Protection of the American Ornithologists' Union have prepared an act which has already been adopted in its main features by several States. At this time it appears probable that, through the efforts of the ornithologists and others interested in protecting birds, this proposed act will ultimately be the basis of protective laws throughout the Union. A copy

of it, which is an amended form of the first draft taken from Bulletin No. 12, United States Department of Agriculture, Division of Biological Survey, page 48, may be found in the Appendix of this book.

But laws are hardly more than "first-aid" instruments,—superficial, and not certain. They are framed and caused to be enacted by a few specialists, who instruct the legislation committee having jurisdiction over such bills, but are not able to reach the people whom the laws are to govern. To the majority the call for protective laws is not understood, if, indeed, the laws themselves are known. Now that adequate statutes are either enacted or may reasonably be expected very soon, it remains to scatter information about birds everywhere, so that laws may be respected, or perhaps become unnecessary. Putting bird protection on a moral basis is a good deal like planting pears,—the returns will be slow in coming, but are certain to come in time. There is no portion of the whole realm of natural history more attractive than birds. People are always to be found who are glad to read or hear about them. Dissemination of facts about birds will do more for their lasting benefit than anything else, and it is in this line that those interested in their conservation should work. There must be lectures, short articles of a popular nature in newspapers and magazines, distribution of government and other publications relating to birds, posting bird laws in conspicuous places, and, most important of all, systematic bird work in public schools.

The importance of engaging the interest of our youth in birds cannot be over-estimated. It results in a double benefit, for the birds will be held in higher esteem and the children will become possessed of a source of lasting pleasure. The nest-robbing, bird-shooting boy and the feather-wearing girl may be made friends and allies of the birds at an expenditure of not over fifteen minutes of school time a week. Fortunately many teachers have lately taken up the study of birds

as a recreation, and thus have been led to bring it into school. A Bird Day is celebrated in many schools, and in at least three States Bird Day is combined with Arbor Day, and appointed by executive proclamation to be observed in schools by appropriate exercises.

While the results of school work are mostly as remote from the application as youth is from maturity, they ought not to be wholly so. As has already been noted, one of the greatest afflictions endured by birds is the nest-robbing small boy. Hunting birds' nests is apparently an original sin, born in the flesh and bound to crop out. Properly handled, it need be neither condoned nor condemned. The considerate teacher will take the bull by the horns by asking his pupils to find nests. He will require an account at stated intervals of the position and architecture of nests, the number and appearance of eggs, period of incubation, and length of time the young remain in the nest. The short-sighted policy of taking eggs will thus be overcome. There should be no honor in failure. None should receive credit who are not able to report the young safely on the wing. Of course the teacher should have a lively interest in the matter himself, and be able to advise in many ways, but this much granted, the plan will work.[1]

---

[1] In this school work The Bird Calendar, by Clarence Moores Weed, will be found useful. It enables the pupil to keep his record clearly and systematically. It is published by Rand, McNally & Co., Chicago.

Photographed from life by Dr. R. W. Shufeldt.

CALIFORNIA PARTRIDGE.

CHAPTER XXII.

THE CONSERVATION OF BIRDS (Concluded).

II. THE GAME-BIRDS.

The term game-birds is at present held to comprise the following four orders of birds: *Anseres*, ducks, geese, and swans; *Paludicolæ*, cranes, rails, coots, and gallinules; *Limicolæ*, shore birds; *Gallinæ*, grouse and quail. The members of the order *Columbæ*, pigeons and doves, have been generally considered game, and still are by many; but these birds have become so scarce that it is plainly unwise to treat them as game any longer. For the same reason certain species belonging to the orders above named should be taken from the game list, temporarily at least. The cranes are such birds. Flickers, larks, robins, and similar birds, formerly called game, as we have seen, by right are game no longer. Either by decrease or by a demonstrated superior living value the accepted list of game-birds has been growing shorter. It is the purpose of this chapter to find the cause and trace the course of this tendency.

Prior to the settlement of America by the whites, and, indeed, for many years after it, the game-bird problem was wholly in the destructive phase. How could enough birds be secured to satisfy bodily needs? was the sum of it. After a steadily-increasing drain for many years, we find ourselves confronted by a different phase, not destructive, but conservative. The question now stands, How can extermination be prevented?

Aboriginal weapons were so crude and furred animals so much more desirable on account of their skins that birds were not seriously persecuted by the red men. The pioneers were better equipped. Like the Indians, they depended on game for their meat supply, and early appreciated the sapid qualities

MAP SHOWING DIVISIONS PROPOSED BY HALLOCK CODE.

The States and Territories are so grouped that game seasons may be uniform, or nearly so, in each division. (*After Biological Survey.*)

of our native wild fowl. Birds were abundant in those days; powder and shot were too dear to be expended on what could not be put to a good use, so we may be assured that the early settlers did not abuse their privileges.

Necessity made man a destroyer of life. Bodily demands first sent him abroad to match human courage against brute ferocity, human patience against brute endurance, human cunning against brute sagacity. He found the excitement of the chase no less agreeable than its products. Hope and fear and victorious exultation combined to fill the hunter's breast with enthusiasm for his pursuit. The peculiar savors of wild meat were sweet to his palate. What wonder, then, that the red man declined to till the ground or that the fathers failed to lay aside the gun when it was no longer needed to supply the family larder.

These two motives—appetite and love of sport—are the roots of the whole matter, and they must be the basis of our investigation. Let us see what each has contributed to bring about the present depletion of game-birds; let us compare their merits, ethical and practical.

As the land became cleared of forests the range of wild creatures was correspondingly restricted, and it was no longer possible for every man to supply his table with their flesh. There was no alternative but to use that of domestic animals in their place. Thus scarcity long since relegated all sorts of game from common fare, but it has ever been held in high esteem as a luxury with those able to procure it. The division of labor that gradually developed produced in turn the itinerant butcher and the market-man. The art of killing and the art of selling were divorced. The market-man gives employment not only to butcher but to a host of others who contribute to the supply of necessities and luxuries that he handles. By combining energy, wealth, and science he has laid under contribution every land, eliminated distance, and defied alike climate and season. It is largely to his enterprise that we

must ascribe the enormous quantities of game-birds that are annually consumed by people who never saw one alive. At his call skilled huntsmen took the field, employing every means ingenuity could suggest to increase the catch. Nets, snares, traps, decoys, and ponderous guns were in constant use. For years professional hunters slaughtered, dealers handled, and gluttons gobbled without reason or restraint. There could be but one result: wild fowl have become scarce. Gunners no longer return at night with more birds than they can carry; not seldom they come in empty-handed. But the millionaire makes up the shortage by paying higher prices. When a pair of canvas-backs bring a five-dollar note there is still money in shooting ducks.

The same lavish fancy that prompts a rich gourmand to buy high-priced ducks prompts him to spend an equal sum for a box of strawberries out of season. The ducks are actually not finer than others of less repute; the berries are not sweeter nor better-flavored than those he buys in spring at ten cents a box. His purchases are made without regard either to cost or intrinsic worth. He has reached a point where gratification outweighs money. But let us see the difference to us whether he spends it for berries or for ducks. When he buys berries he pays the gardener a special price for a special kind of skill and for maintaining an expensive establishment a fair recompense. The fruit is as truly the sole property of the horticulturist as is the money the sole property of the purchaser. The transaction is legitimate. Now as to ducks. The gunner receives pay for skill and toil, as in the other case; but the birds are his only by an acquisition not wholly above question. He has spent nothing on their nurture. He disposes of what we have as clear a title to as he if we would but make it good by scouring the marshes. Such a title may not be very strong, but it has a certain validity nevertheless. As a democratic people, there is but one light in which we can regard game,—that is, as public property. If there were an inexhaustible

supply there would be no ground for conflict between commercial and private interests; but the supply is already alarmingly diminished, and we cannot doubt that traffic has been a large factor in making it so.

When this country was first settled predaceous animals were troublesome. Bounties were offered for their scalps. For the most part they are now extinct in the older localities. A price on the heads of hawks has reduced them to absolute scarcity in most parts of the East. It was put there for that purpose, and there is general gratification at the success of the plan. Who will contend that a price on a bird's body is likely to prove any less fatal to the bird, as a species, than if it were a premium on heads? Various persons at different times have advanced arguments in defence of selling game, and at the same time have offered plausible advice as to how it might be done without endangering the stock. It has generally turned out that a personal interest lay at the bottom of such advocacy; it might be a share in a cold-storage plant or a private game preserve that needed more freedom in management to become profitable. So long as there is a money value on game-birds, so long will there be a standing army of gunners harrying hill and dale, marsh and shore,—a shiftless, irresponsible company, who prefer the excitement of the hunt, although coupled with precarious returns, to regular employment and a certain wage,—shooting without mercy, insatiate.

Although America cannot boast of so large a variety of quadrupeds as the Old World, her wild fowl are unexcelled in variety, numbers, or gastronomic qualities. Persons expert in handling a gun find them incomparable as a source of sport. No amount of the smaller four-footed game can bring to the heart of the true sportsman the satisfaction he feels when he stops the headlong flight of a grouse or duck.

Hunting has always had many devotees who have followed it simply for pleasure. To be a successful hunter of wild fowl one must have a taste for it, keen senses, and no mean skill.

To such an one it is a prime diversion. The days allotted to it are landmarks in anticipation and remembrance. Thoughts of autumn keep a multitude contentedly at the plow, the bench, and the desk, resisting the appeals of spring and the torrid oppression of summer. For most men there is no pleasure in the sight of flowing blood or broken bones or gaping wounds or glazing eyes. It is not these concomitants of death nor death itself that are enjoyed. Enticement afield lies rather in the fortunes of chance and the exercise of ability, in the thousand delights to eye and ear in the haunts of nature—woods, water, busy insects, flitting birds, the gorgeous coloring of autumn leaves, shy plants that blossom only in the shade. Chasing the quarry is but a string on which these things are strung. Grief bids farewell, care and melancholy go away, when one turns nimrod, as naturally as hunger follows fasting or sleep the labor of the day.

With many, perhaps the majority, who shoot birds, sport is the main thing; the game, after it is secured, being secondary, —hardly more than incidental. The diversion of mind, the increased vigor, the excitement at the critical moment, and a reasonable number of hits are sufficient returns for all the discomforts endured. The tender, woodsy-savored breasts at supper, to crown the day, are perquisites. But, unfortunately, there are men among the legion included under the title of sportsmen, as distinguished from market-gunners, who have never learned the virtue of moderation. They are never satisfied; they cannot kill enough. No matter how many birds they see or how little use they may have for them, they kill and kill, so long as any are in sight or there is a shot in the locker. The term "game-hog," which has been applied to this sort of a sportsman, is pat. His place is at the bottom of the shooting list. The market-gunner has a poor business, but he has at least a tangible excuse for killing all he can. For the "game-hog" there is no extenuation, unless we credit him with a weak mind.

The number of sportsmen has constantly increased. This happens mainly as a result of increased population, though it has been assisted by modern inventions. Improvements in fire-arms have made successful hunting more sure.

Railroads have penetrated wilder lands and afford easy facilities for reaching good grounds that otherwise would be inaccessible to the average gunner. When we reflect that game-birds showed a diminution in numbers a hundred years ago, it is a wonder that, with the increasing forces working against them, there are any left. So prevalent is the hunting spirit that, as in other branches of human interest, fraternities have been formed. Sportsmen's clubs and sportsmen's leagues are many. Newspaper and magazine publishers cater to sportsmen by devoting more or less space to sporting news. Wealthy men, fond of shooting, club together, gain control of favorite game resorts by purchase or lease, and erect expensive houses thereon, in order that they may not forego home comforts while engaged in shooting. Along the coast and on the borders of the great lakes are many such tracts, held for duck and goose shooting. In the primeval woods are many others. Such conveniences attract men who otherwise would not care to endure camp-life, and thus add largely to the foes of game-birds. There is another side to this, however, which is important, for it may prove the salvation of the birds,—the men of wealth and influence are made aware of their scarcity. Their investments in club properties as well as their love for sport give them an incentive to try to mend matters. In a number of instances they have replenished their covers with imported birds. They establish rules to regulate shooting on their territory, they influence public sentiment by appeals through the press, and direct legislation with a strong hand. There are many sportsmen, without property rights, in favor of adequate protection, who are ready to quit when they have killed a reasonable number of birds. Such men are the right sort of leaven; they can preach the doctrine of conservation with

effect, for they practise it, and cannot be accused of selfish motives. As editors and contributors they have already awakened a wide-spread interest in the protection of game, and it is largely through their labors that protective laws have been spread on the statute-books of every State in the Union.

In our examination of motives we have seen that, though differing in kind, they have worked together along the same line towards the same result. So far as effect goes, they have been practically a unit, and in tracing the progress of decrease need not be separated. It is when we consider preventive means that a distinction should be made between them.

In the early days game was taken at all seasons and by every available means. The settlers were not in a condition to think of ultimate results, and their successors did not take the pains. For many years wild fowl were so plentiful that the idea that they might become scarce probably did not occur to people in general. To kill a female bird in spring virtually destroys a whole brood for a gain of one—a poor one at that. In spite of the plain improvidence of killing at all seasons, it was continued for generations after it was noticed that birds were growing less. So it was with traps, nets, and swivel-guns. As a specific illustration of the results of injudicious killing and of the prevailing negligent spirit with which it was viewed, let us look at the history of New Hampshire. Being one of the older States, the history of its game is practically a chronicle of that of other older States and a prophecy of that of the newer.

New Hampshire was first settled in its southeast corner, near the sea, about the year 1623. Its forests were dense and its soil stubborn, so that its occupation was very gradual. In 1792 Jeremy Belknap published a history of the State, in which was given a list of its birds. Among them were four game-birds that no longer have a place there. They were the sand-hill crane, the heath-hen, the wild turkey, and the passenger pigeon. The crane was even then presumably rare,

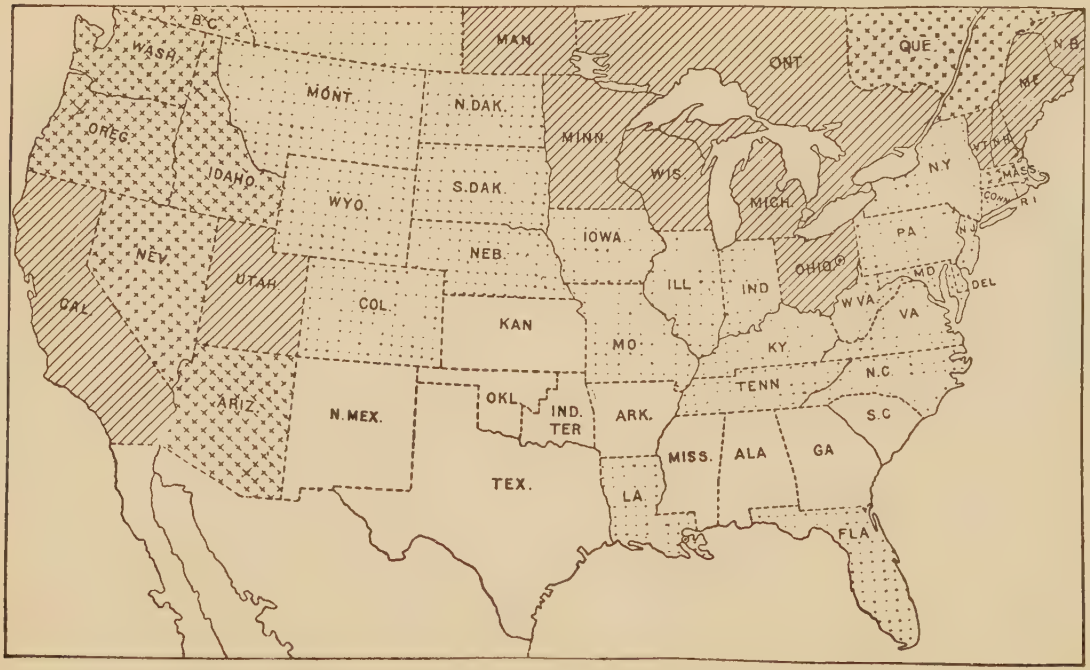
though at about the same time Samuel Williams wrote of them as among the commonest water-birds of Vermont. Be that as it may, during the nineteenth century only one sand-hill crane is known to have been taken in New England. This accidental pilgrim to the land of his forefathers was killed about 1896, near where New Hampshire was first settled. Heath-hens long since vanished from the State, and the only remnant of the race left in New England is among the dense brush-land of Martha's Vineyard, off the south coast of Massachusetts. The wild turkey has also disappeared. Nobody knows when the last one was killed. In Massachusetts they were occasionally seen down to 1847. It is to be sincerely regretted that such birds are gone, the turkey and grouse especially, for no finer game-birds exist the world over. But as a striking example of the effect of ceaseless slaughter the wild pigeon is pre-eminent. Belknap, quoting from the journal of Richard Hazen, who surveyed the province line in 1741, says, "For three miles together the pigeons' nests were so thick that five hundred might have been told on the beech-trees at one time." Before the end of that century pigeons were greatly reduced, though still abundant. Persons now living remember when netting and shooting pigeons at "beds" was a common practice. They brought but a trifle per dozen, yet many men were in the business of capturing them for market. The decrease was more and more rapid as years passed. By 1850 they were scarce. Twenty-five years later they were rare, and in ten years more not one was to be found. Ten years after their disappearance the State legislature passed a law prohibiting the killing of pigeons for a term of three years.

But it is not the exterminated species alone that deserve attention; indeed, they are "spilt milk" and may as well be forgotten, unless we can turn their fate to account in perpetuating those that are left. The worst sufferers in New Hampshire to-day are the water-fowl and shore-birds, especially

near the coast, where most of them are exclusively found. A conservative estimate of the average annual slaughter of water-fowl—ducks principally—on her eighteen miles of coast and adjacent brackish waters, is five thousand. Half that number are sometimes killed off a single promontory,—Boars Head, at Hampton Beach. The majority are shot for revenue only. The older hunters are unanimous in saying that all sorts of water-fowl are scarce compared with what they were fifty years ago. Of the myriads of plover, snipe, curlews, and sand-pipers that formerly thronged beach and marsh only a fraction remain. The number of gunners that follow them is so great and the area they frequent is so wide that any estimate of the yearly capture is hazardous.

Birds have been killed faster than they could multiply. At first it was not realized, but it was known so long ago as Belknap wrote, for he relates that "some of our epicurean gentry" had already begun to fear for the ruffed grouse. Thanks to its peculiar habits, that royal bird still inhabits its native heath. In spite of the fact that the decrease was apprehended, it was more than fifty years before the mental inertia of the people was overcome sufficiently for them to take active measures to stay it. Three game-birds had suffered extinction and a fourth was on the brink when the first step was taken.

The first game laws enacted related to time and method of capture. Spring killing and trapping were the earliest prohibitions. Only a part of the permanent resident birds were given even this protection. As time went on the number of protected birds and the period of their protection were gradually increased; but it was something like forty years after the initial law before the game-birds found in the State were given a closed season. In spite of statutes regulating seasons and methods, it at length became apparent that the decrease was not wholly checked, and further measures were taken. It was made an offence to send dead grouse



MAP ILLUSTRATING THE NEED OF GREATER PROTECTION FOR WILD DUCKS.

Blank areas indicate no protection; dotted areas, protection chiefly between April and September, when most of the ducks have gone north to breed; crosses, partial protection during spring migration, close seasons beginning in March; and ruled areas, complete protection during spring migration, close seasons beginning on or before February 1. Under ideal laws the entire map would be ruled. (*After Biological Survey.*)

and woodcock and plover out of the State. Public opinion favorable to the protection of game has been steadily growing. A State game and fish commission, having game interests in charge, superintends the propagation and distribution of game and prosecutes offenders. This, in a nut-shell, is a history of game-bird relations in New Hampshire.

In other States the story runs much the same. A pronounced falling off in the number of game-birds is acknowledged everywhere. Some States have been more prompt with measures to prevent it, some more tardy. New York passed a law protecting heath-hens in 1791, but so late as 1874 only twenty-four States and territories had game laws. At present every State offers some protection. Nineteen prohibit market hunting or the sale of game at all times; forty prohibit export; fifteen require that non-residents shall procure gun licenses, and several of them make the law apply to residents as well, though to them licenses are issued at a nominal rate. In twelve States there are laws limiting the number of birds that may be killed by one person in a day. Although the need of game protection was a long time in impressing the public mind, when once aroused, the sentiment in its favor rapidly gained strength. There is scarcely a legislature that is not asked to do something to help it along.

One of the greatest difficulties in the way of a general endorsement of, and respect for, the laws as they now stand is the lack of uniformity which they present. One does not mind refraining so much when everybody else has to refrain too; but when he sees his neighbors doing what he is enjoined not to do, there is a temptation to rebel. When there is a variance in the laws of the adjoining States there is sure to be poaching near the boundary. One State allows spring shooting of water-fowl, the next prohibits it, yet they have a continuous coast-line or are separated by a river. There is injustice when slaughter must cease at an arbitrary line which has no natural significance. Those who kill illegally under

such circumstances always defend themselves on this ground, though it may not be the real cause of their crime. In spite of the fact that it cannot save them from punishment if they are prosecuted, it undoubtedly keeps down the number of complaints that reach official ears. Officials themselves are likely to give most of their attention to other parts of the State.

As an example of non-uniformity take Iowa and her immediate neighbors north and south, Minnesota and Missouri. The close season for ducks in Iowa is April 15 to September 1; in Minnesota it is January 1 to September 1; and in Missouri April 1 to October 1. Iowa gunners are allowed to kill ducks six weeks longer than Missouri gunners, and thirteen weeks longer than Minnesota gunners. If ducks were permanent residents such discrepancy would not matter, but the majority of them are migrants, exposed to fire from each of the three States in succession. The laws relating to other game-birds in these three States are no nearer alike. Neither are game laws of other contiguous States better in this respect. In the statement of close seasons in the different States and territories issued by the Department of Agriculture[1] there are not three successive States with uniform laws relating to a single game-bird, with the exception of Utah, Idaho, and Washington, which agree in protecting grouse and prairie chickens. This condition of things is manifestly wrong, and so long as it continues the laws in question are certain to be violated. Popular sentiment will not uphold them. It is not practicable to police every bit of woods, every stretch of water, every grain-field. If game laws do not meet the approval and have the hearty support of the masses, they are void.

The palpable impropriety of prohibiting on one side of a certain line what is openly and legally practised on the other can lead to but one outcome—defiance. That the State is the sovereign power, so far as its internal affairs are concerned,

[1] Bulletin No. 14, Division of Biological Survey.

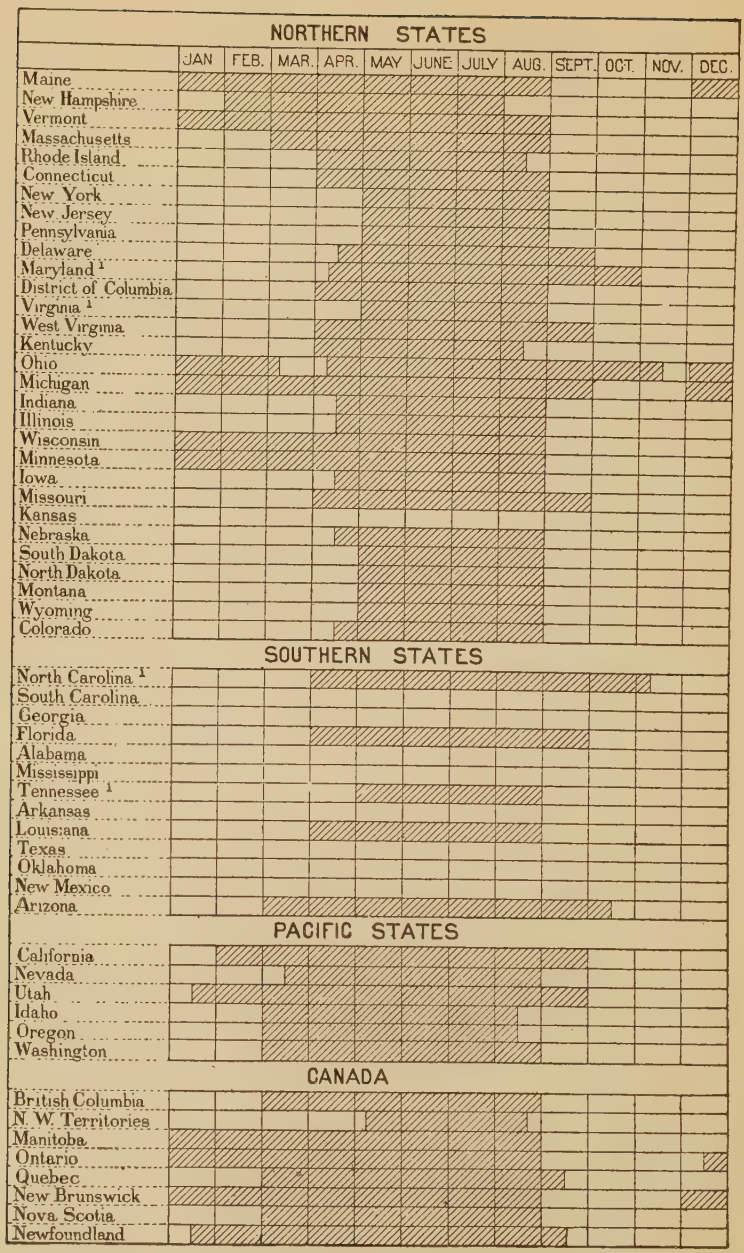


DIAGRAM SHOWING CLOSE SEASONS FOR WILD DUCKS IN 1901.

The shaded areas indicate close seasons. [1] Seasons vary in different counties. (*From Biological Survey.*)

is no reason why States should not and cannot agree to concerted legislation. In this, as in all movements involving numbers, there must be pioneers,—individuals to move first. There have been pioneers. New York was the first one. To-day there are all degrees of protection offered. In a few States it is nearly or quite up to the desires of those who have given the subject most thought. It now remains for others to get in line.

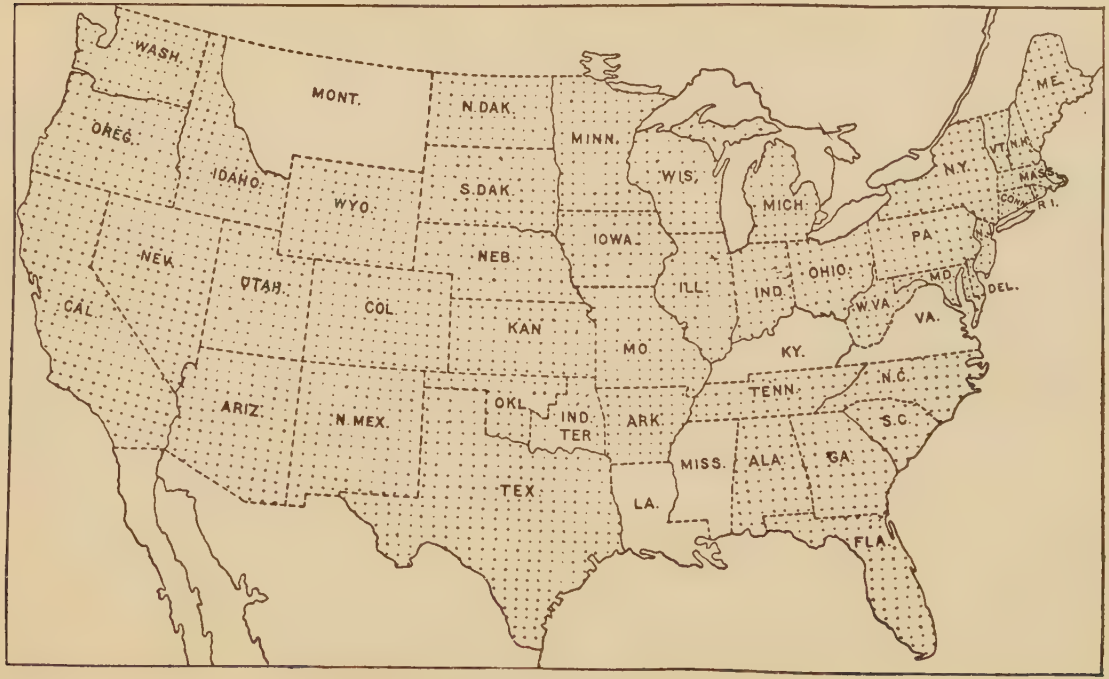
A suggestion made by Mr. Charles Hallock, in an address to the National Game, Bird, and Fish Protective Association, in 1897, relative to uniform laws, is worthy of notice. He proposed a division of the United States into three districts which might readily adopt game laws of the same general tenor, if not actually identical. The original scheme of Mr. Hallock, somewhat modified as to boundaries, was presented by Messrs. Palmer and Olds, of the Biological Survey, in Bulletin No. 16, United States Department of Agriculture, from which the map at the beginning of this chapter is taken. The Rocky Mountains form a natural barrier between the Northern and Pacific divisions, while the line between the Northern and Southern divisions is established with reference to climate. This plan is worth trying, if not in detail, at least as a working basis. Undoubtedly as soon as those interested in the preservation of game thoughout the Union are better organized, some such scheme for securing a reasonable uniformity will be carried into effect.

An important piece of legislation in favor of birds is the Lacey Act, so called, a national law, approved May 25, 1900. By the provisions of this act the preservation, distribution, introduction, and restoration of game-birds and other birds is included in the duties and powers of the Department of Agriculture. The Secretary of Agriculture is authorized to purchase and distribute such birds as may be required, subject to the laws of the various States and Territories; and also from time to time to collect and publish useful information as to their

propagation, uses, and preservation. The importation of foreign wild animals and birds without a special permit from the Secretary of Agriculture is made unlawful. The introduction of English sparrows and starlings is specially prohibited. This act also prohibits interstate commerce in the dead bodies of animals or birds, or parts thereof, when killed contrary to the laws of the State or if the State prohibits their export. All birds, or parts thereof, when brought into a State are subject to the same laws that would apply in case the birds were produced in that State. This act is designed to supplement State laws and to give a double check to transportation of game by bringing to bear on each transaction the laws of the State.

Besides the protection afforded by game laws, there is the method of establishing preserves where birds are either given complete immunity from slaughter or are carefully guarded from excessive depletion. The associations of wealthy sportsmen that exist in various parts of the country, where they control much land, look after their game very carefully, as has already been stated. Such preserves are maintained at so large an expense that they can never become numerous enough to be of appreciable assistance in repopulating the woods. But it is perfectly feasible for owners of adjoining farms, if they are so minded, to combine their properties into preserves that would accomplish everything. A tract of land comprising ten or a dozen average farms, thus set apart by mutual consent as a section where no birds should be killed, would become a reservoir, the overflow from which would afford excellent sport in the surrounding region. Birds would not only become more abundant, but the danger of extermination would be out of the question.

In *Bird Lore*, June, 1901, Mr. Willard G. Van Name, of New Haven, Connecticut, gives an account of a preserve of this sort that has proved all that was hoped for it. This preserve, comprising between one and two square miles of farm- and woodland, is in the vicinity of New Haven. It was organized

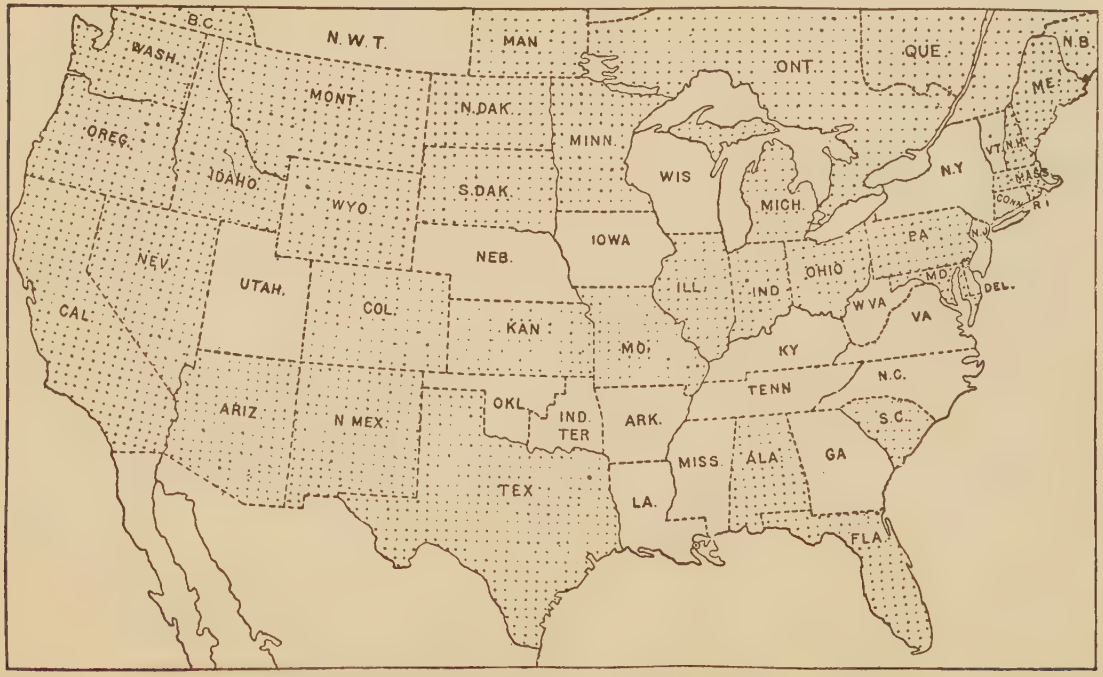


STATES (DOTTED) WHICH PROHIBIT EXPORT OF GAME.

(After Biological Survey.)

by Mr. E. Knight Sperry, of that city. Mr. Sperry first obtained permission to try the experiment from the seven or eight owners of the land, on condition that neither he nor they should shoot there, and that he should bear all expenses, while they were to enforce prohibition. The chief expense was for signs forbidding shooting. A few quail were turned loose each year, though it is now thought that was unnecessary. Ruffed grouse were left to increase as they could. Small patches of wheat or buckwheat were sown to keep the quail from starving or wandering in search of food during the winter. Almost immediately an increase was noticed, and soon the birds became very abundant on the preserve, and now there is good shooting on the neighboring farms where formerly very few birds were to be had. The land-owners are so well pleased with the plan that none have withdrawn from the compact, although they are all at liberty to do so at any time.

It is well known that both quail and grouse prefer to live either on or near cultivated land, where food is abundant. Farmers might easily combine in this way, thereby affording better sport for themselves, or increasing the attractions of their town for outside parties who for the sake of the birds would be glad to come and pay well for shooting privileges. In many sections the city boarder has become the farmer's best source of revenue. If he will protect his grouse and quail, he may sell them in the brush for more than he could realize by killing them himself and putting them in market, and at the same time extend his boarding season well into autumn. A city sportsman, whose time has a value, is glad to pay for a certainty of finding game. Although game is held to be the property of the State rather than of the individual owning the land that supports it, he may still be the sole beneficiary if he will. He must obey the statutes, even on his own land, but he can profit in due season by his own restraint, for no one else can trespass on his premises if he forbids it.



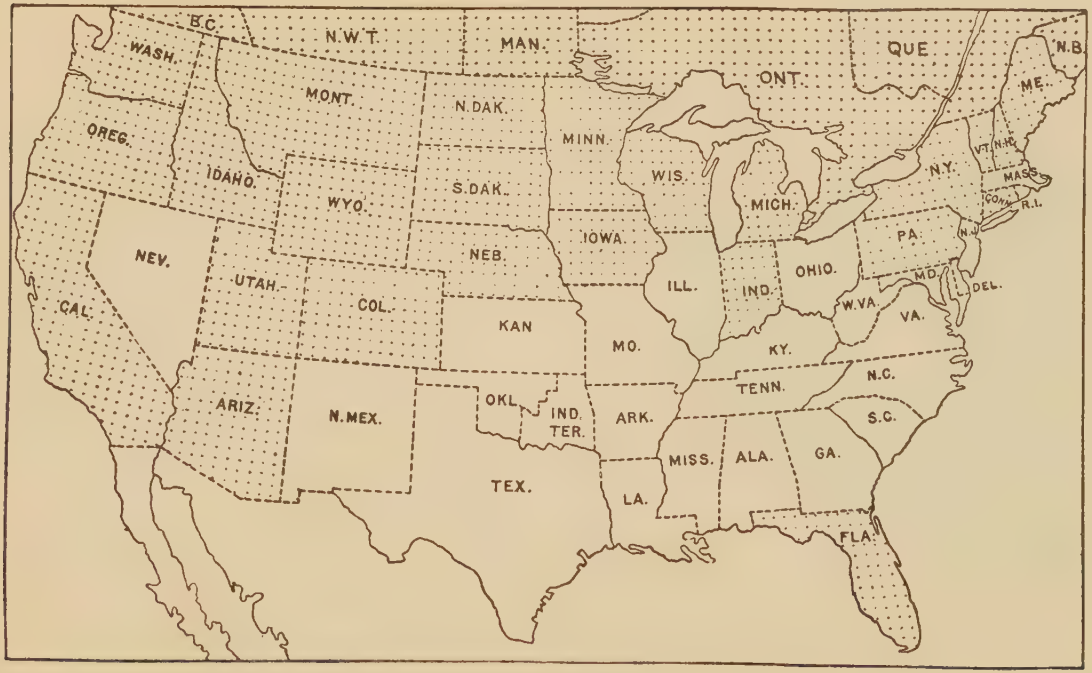
STATES (DOTTED) WHICH PROHIBIT SALE OF CERTAIN GAME AT ALL TIMES.

(*After Biological Survey.*)

To review this matter: The stock of wild fowl has reached a low ebb through a long-continued and ever-increasing persecution and an ever-narrowing breeding range. Two different motive forces have pushed the persecution,—the market and an inborn love of hunting, the one commercial—a matof dollars and cents—the other a natural instinct. The one gratifies the few that earn a meagre living by hunting and the few rich enough to buy; the other may be enjoyed by every man able to leave his place of business if he so elects. The one breeds dyspepsia, the other vigorous health. The one benefits classes, the other masses. Nothing in Euclid is more clearly demonstrated than that their combined drain is altogether too great to be borne. One of them must be put out of action. Which? We have seen that several States have decided already. Selling and killing for sale are prohibited. When our uniform laws are come to pass, that clause will be a part of them. Moreover, the number of birds that may be taken in a day will be fixed low. Then spring will be a close season everywhere, and the open season will not be longer than two, or possibly three, months, varying in time according to the habits of the different species.

But the main thing, after all, is popular education along this line. There is a contagion in reform. That infection has begun is evident. All having the preservation of birds at heart must help spread it by precept and example. By care the stock may be replenished and the birds indefinitely preserved,—a continued source of benefit to us and a worthy legacy to posterity.

Aside from schools there are certain organizations through which the idea of bird protection is promulgated. Of these the American Ornithologists' Union, which is devoted to all phases of bird work, is the most comprehensive. Its membership embraces many able men who have contributed liberally to current literature upon this subject. The many branches of the Audubon Society, especially arrayed against the use of



STATES (DOTTED) WHICH LIMIT GAME BAGS.

(*After Biological Survey.*)

bird skins and feathers for millinery purposes, is closer in touch with the people than any other organization of its nature, and as an educational factor is of prime importance. The League of American Sportsmen, although, as its name implies, devoted particularly to the protection of game, also champions the protection of birds. These societies have dealt largely with the ethical and æsthetic side of the question.

The economic side has been ably discussed in a number of bulletins and Yearbook articles from the Division of Biological Survey of the United States Department of Agriculture which have been freely circulated.

Thus, while it appears that the decrease in birds is real and the causes numerous and difficult to combat, there is a definite movement against it, which, although late, is now gaining strength and breadth and seems in a fair way to arrive at a successful issue. In some regions very encouraging results have already been reported.

GREAT HORNED OWL.

CHAPTER XXIII.

PREVENTING THE DEPREDATIONS OF BIRDS.

About the only real interest the average farmer takes in birds relates to methods of preventing the depredations of the few species that are inclined to share with him the fruits of his labors. He accepts their benefits, as he does those of rain and sunshine, as a matter of course. He is free to avail himself of any or all natural products that are favorable to his welfare, so far as lies in his power, and also to avoid such as work him harm, to the same extent. While he may not exhibit a proper spirit of gratitude for past favors, when he prevents robins and cedar-birds from taking his cherries he is at least practical. The knowledge that crows and blackbirds devour multitudes of insects is poor consolation for a ruined crop. When such birds are made to desist from spoliation, not only is the harvest insured, but the birds are thus made to destroy more insects, thereby turning threatened injury into real advantage. To protect crops from the ravages of birds is quite proper and legitimate.

It is easy for one who realizes the great value of birds to let his gratitude get the better of his common sense, particularly if he owns nothing that birds interfere with. "There is a time to every purpose." The time to show gratitude to birds is when they need it. The man who values birds because they are useful to him, or because he loves them, is ready to feed them when food is scarce, to offer them nesting facilities, and to protect them against their enemies. But when his fields are burdened with grasshoppers there is no need for him to allow robins in his berry-patch or blackbirds in his corn.

Birds may well be classed as natural resources. From this

view-point they are not unlike seaweed thrown upon a beach or a muck-pit on a farm. They all have a real value if utilized, though none of them are absolutely essential to a fair crop. It is not less a sign of thrift when a farmer tries to get the most out of the birds about him than it is when he tries to get the most out of his bog or beach. It is true, birds will work to his betterment though he ignore them, while such resources as muck and seaweed yield nothing without his attention. But it is not less true that intelligent effort is as sure of reward in bird-husbandry as it is when applied to resources that are wholly potential without such effort.

No prudent farmer will leave the birds out of his plans. He will attract them by ministering to their needs. In his dealings with them he will be guided by the same motives that direct his actions towards his domestic animals. His cattle and his poultry are fed, housed, and slaughtered, all for his personal benefit. So long as his animals are more profitable living than dead, he cares for them; when they are fit for market, or vicious, he kills them as unhesitatingly as he has nurtured them. There is no reason why this same sort of management should not be applied to birds. An unprofitable oriole should be killed as promptly as an unprofitable sheep. But sheep are not slaughtered for their sins or their infirmities so long as they are of more value living than dead. We do not kill our animals for faults we can correct. The flower-loving housewife fences round her posy-bed, covers it with brush, or even applies socks to the feet of the chronic scratchers among her fowls sooner than take off their heads for unearthing seeds. When birds are turned away from marauding by some harmless device, not only are their lives spared for good work in the future, but they are often turned to better business at the moment.

In the study of ways and means for preventing the depredations of birds, their ordinary utility should never be lost sight of. That should be the basis upon which all plans for

their regulation are formulated. Moreover, the sins of the individual ought not to be saddled on the whole of its race, as is too often done. Because one red-shouldered hawk, for instance, comes to the yard and carries away chickens, the next ninety-nine, which are worthy pursuers of mice and similar vermin, should not be sacrificed for the sins of the guilty one. This is one of the gravest errors to which birds are subjected. When people learn to discriminate as carefully between good and bad wild birds as they do between good and bad domestic birds, they will have learned an important lesson, both for themselves and for their feathered benefactors. No person is qualified to deal repressively with birds who has not a thorough knowledge of their habits. Possessed of such knowledge, one is able to work intelligently to avail himself of their benefits in fullest measure and to give in return the least possible compensation.

The number of birds that are harmful, including those but partially so, is so small that it would seem an easy matter to control them. A few species destroy grain, a few injure trees, a few purloin fruit, and a few steal chickens. These culprits, all told, are but a small fraction of our avifauna. But though the species that need regulating are few, several of them are so numerous individually that the damage done is sometimes serious. The worst offenders are those that invade grainfields,—that is to say, crows, blackbirds, bobolinks, jays, and their kin.

As grain thieves, crows are most notorious of all, from the fact that they are more uniformly distributed, and also because they pay particular attention to sprouting grain. Their superior size enables them to pull up the planted seeds, and correspondingly large quantities are required to satisfy their hunger. Moreover, crows are in a class by themselves on account of their cunning. By experience they have learned to work on the sly and to avoid the machinations which men would employ to destroy them.

If crows were less wary, so many would fall victims to the wrath of planters that their extermination in the cultivated portions of our country would soon come to pass. They come nearer to living by their wits than any other birds we know. However, their sagacity is not useful to them alone; it makes it possible for us to avoid their villanies by exciting their suspicions. Thus, on the whole, we have reason to be glad that crows are as wise as they are, for we know that their annual consumption of insects is enormous, and that it is unquestionably better to keep them away from the fields a week or two in seed-time than to destroy them, and thus to lose their assistance.

We are inclined to believe that if farmers dealt with crows as intelligently as crows deal with farmers there would be vastly less heard about the injury they do. The boy who put his finger to the dim edge of a humming buzz-saw, with the remark "It looks as if it were there," was accustomed thereafter to rely more on vision. The man who expects windmills, scarecrows, old newspapers, bottles, and sheet tin to protect his field, when he has seen them fail year after year, needs some such lesson as the boy had to make him more acute. "Br'er Rabbit" is scarcely more at home "in a briar-patch" than crows among these harmless objects, with which they have been acquainted from youth up, and which were never known to harm anything.

They soon learn what is dangerous and what is not. If one is shot or poisoned or caught, his comrades remember his misfortune and thereafter avoid the place of its occurrence. They are so apprehensive of danger that they seldom alight near one that is dead, though it may never have been a companion.

Crows are accustomed to do most of their foraging very early in the morning and on rainy days. The farmer who neglects to traverse his corn-land at these times is sure to rue it. They will take advantage of a dense fog, and attack fields they would hardly dare fly over in good weather.

Ordinarily, a field covered with a network of twine strung on poles will not be molested. The twine is usually strung along a few feet from the ground, at intervals of two or three rods.

A dead crow thrown down upon the ground or suspended in the air is also almost certain to deter them from venturing near.

Poultry placed in boxes heavily slatted, so that the presence of something alive will be manifested without exposing the real nature of the contents, make very good scarecrows. Two or three boxes to the acre, one fowl in each, are sufficient.

Another method, one that appeals to taste instead of sight, is to flavor the seed before planting with coal-tar or oil-of-tar, which crows dislike. The corn is first soaked in water, and then enough tar or tar-oil is stirred in to give each kernel a thin coating. Plaster is then added to render the corn more easily handled. Objections to this method are: It does not admit the use of a planter and it retards germination. Though usually effectual, this method is said not to be infallible.

Fields that are isolated, so there is no possibility of their being visited by domestic animals, may be protected to a certainty by scattering broadcast a little grain that has been soaked in water in which some strychnine has been dissolved. Poisoned grain should be carefully dried before being put out, in order to make it appear natural to the critical invaders. One or two killed, or even made sick, will settle the crow question for that year.

Not a few farmers are accustomed to scatter small quantities of grain—not poisoned—in their fields two or three times a week during the period when crows are troublesome. They say the crows thus obtain all the grain they want without pulling up any. They also claim that the crows pay well for the grain by destroying cutworms and other injurious larvæ that infest the ground. With highly moral crows this plan is more philosophical than any we know. But some

crows are depraved. We have even known a tame crow, reared in opulence, exposed to the influence of honest principles, away from all of its kind, a crow that disdained corn as a food, and yet which, constrained by a hereditary taint of evil, was accustomed to pull it right and left, only to throw it down again. He began to pull corn before he was a year old. After this experience we are not surprised to learn that crows sometimes pull corn when there is plenty above ground.

There is certainly more difference in crows than appears as they fly over. Schemes that serve to keep them from molesting corn in one place are frequently useless in another. Moreover, it sometimes happens that a remedy employed with success year after year in a given locality suddenly becomes ineffectual. All naturalists who have had occasion to examine a large series of specimens of any sort of organism are well aware that there is always considerable variation among them in size, proportion, or color, as may be. Now it surely is not preposterous to suppose there are psychic variations as well as bodily variations. Variations in size or proportion of parts, when associated with environment,—climate, soil, food, etc.,—are sufficient to account for geographical races or even species. By analogy it is not difficult to set up a working hypothesis to account for the occasional failure of devices that previously had been successful. The crows that have inhabited a given locality for generations, we will suppose, have a particular fear of the twine put up on corn-land, suspecting it to be a kind of trap for their entanglement. Another race in another region, from a less painful experience with traps, or with enough intelligence to see there is no danger in it, or with too little to suspect any, regards twine with indifference. Again, an old fear may wear off with long familiarity or be removed by an improved temperament, while a fatal lesson or an increasing wariness of purely organic origin would account for a new fear.

Whatever may be the philosophy of the ways of the crow

there is no doubt that he will bear contemplative observation. Any person interested in agriculture who will make himself acquainted with the habits of this bird will be convinced that it is emphatically worth while to make every effort to avoid its depredations by harmless means.

Where granivorous birds other than crows have injurious habits, eternal vigilance appears to be the only means of defence. Jays are occasionally thievish when corn is ripe. Blackbirds pick up newly-sown grain and also plunder the matured crop during their autumnal movements when they are in flocks. Bobolinks are mischievous only in the rice-fields, but there they are so bad as to be absolute pests.

Fortunately, in most localities none of these birds do appreciable harm. Only fields adjacent to woodland are raided by jays. Blackbirds make their head-quarters in marshes during spring and summer, and therefore the range of their operations is restricted. In sections visited by the immense flocks that assemble to spend fall and winter together there is always more or less complaint against them. But it is not always safe, when blackbirds are in a grain-field, to infer they are doing harm. We know an instance in which a farmer killed numbers of them, fully believing them to be eating his grain, but when their stomachs were opened it was found they had taken nothing but insects. It is generally true that the drafts made by any of these smaller grain-eating birds are more than compensated for by the good they do. For this reason they should never be molested unless it is certain they are eating grain.

None of these birds are susceptible to any but human scare-crows. Images, traps, cages, dead of their own kind, have no terrors for them. Half a flock may be shot down one day, and the next the surviving half is as likely to visit that field as any other. They do not appear to have an iota of the keenness that characterizes the crow. This inferiority in mental capacity is an unsurmountable obstacle to avoiding their dep-

redations by harmless means, except at an attending expense too great to be borne by small farmers. Where large tracts are under cultivation it is feasible to employ boys to stay in the fields while there is danger from birds, to keep them off, provided boys are to be had.

On some of the rice-plantations in the South men and boys are supplied with arms and ammunition and kept in the field during the migration season. They shoot to kill and to frighten, to give flocks on the ground a good send-off, and to keep those in the air from alighting. A constant fusillade is kept up for weeks. It is an expensive method, but nobody has been able to show a better one.

In view of all that we know of the economic qualities of these birds, the wise course appears to be to molest them only when beyond a doubt they are in mischief. An entire flock will leave a field in as much haste, go as far, and remain away as long as half of it; so, unless there be malice to satisfy, a blank shot is as good as a full charge. The only advantage of putting a gun in a watchman's hand is to enable him to cover more ground. The birds are as afraid of him without a gun as with one, the only difference being that they are sooner aware of his presence.

The chief purloiners of small fruits are cedar-birds and robins. As has already been shown in Chapter III., a large number of birds eat fruit, but the majority are satisfied with the wild varieties that grow in their accustomed haunts. None of our Northern birds feed so largely upon soft fruits as these two, at least not in spring and early summer.

Cedar-birds are essentially frugivorous, though they catch many beetles and other flying insects, particularly in spring, when there is not much fruit to be had. They go in flocks, and when they come to good feeding, stay by as long it lasts. They are nearly indifferent to man, being neither wary nor familiar. High living is their main object in life. Berries in a suburban garden or on an uninhabited mountain are quite

the same to them. But, though cedar-birds do not hesitate to visit populous quarters when the best fruit is there, as soon as wild lands come into competition they are ready to withdraw.

The case with robins is somewhat different. They rely on man in a measure. Their line of distribution has extended very much according to his. They choose to build their nests in orchards and to seek their living on cultivated ground. On small farms, in country villages, and in city suburbs they are most abundant. Berries constitute more than half their normal fare.

When orchards are occupied by frugivorous birds, fruit is bound to suffer unless the ratio of fruit to birds is very large. It is a fact that most complaints against robins and cedar-birds come, not from the extensive producers, but rather from those who cultivate small gardens to supply their own tables. Early varieties of strawberries and cherries suffer most largely, for the reason that wild fruits are not yet matured. Many an anticipated treat on home-grown berries has been defeated by robins and cedar-birds. Shooting is frequently resorted to. Brooding birds are slain, foliage, fruit, and branches are punctured, yet the fruit is neither saved nor paid for.

It is not uncommon to see cherry-trees decked with bright-colored cloths. The birds reconnoitre a little, but very shortly the gay trimmings only serve to garnish the feast. We have known a stuffed hawk placed in a tree to keep them away for a day, but no longer. The only sure way of preventing the depredations of these birds is to cover the fruit-bearing plants with netting. Of course this is practicable only in case of small quantities or rare varieties. Any sort of netting, coarse mesh or fine, will answer the purpose.

Where there is plenty of land, there is no way so satisfactory, on the whole, as to set out other berry plants, such as the Russian mulberry, for instance, which are ornamental when in bloom, make good shade, and will be patronized by

birds, to the relief of the garden. By this means it is possible to retain both birds and berries.

Of all bird invasions none are quite so exasperating as those of the rapacious species, the owls and hawks, which not only rob us, but lacerate and kill helpless, harmless creatures which, by their dependence upon our care and bounty, have a share of our affection. The loss is vexatious; the cruelty is maddening.

Owls do relatively little harm, and there is really no excuse for permitting them to do that little, for it is only necessary to make fowls roost indoors to avoid it altogether. No such simple means can be employed to prevent the raids of hawks. When pushed by hunger, hawks have no fear of man or any of his inventions. They dash down and clutch a chicken in a village street with as much assurance as if it were in a secluded meadow. While it is apparently out of the question to keep hawks away by fear, at least of inanimate objects, it is possible to employ to our advantage the hatred or fear which other birds have for them.

Kingbirds never allow a hawk to pass them in peace. There is no better insurance against hawks than a family of kingbirds located near the poultry-yard. An apple-tree inclined to grow scraggy, if left untrimmed, is likely to prove the most profitable tree in the orchard, for it is almost sure to be selected by a kingbird for a nest-tree. A bird-house, when tenanted by a family of purple martins, will answer the same purpose. Martins have a hatred of hawks nearly equal to that of kingbirds. A well-built martin-house, one that suits these rather exacting birds, will prove a good investment in any farm-yard.

Some poultrymen keep a few guinea-fowls for the sole purpose of alarming hawks by their harsh clatter. Like turkeys, the days of their wild state are not so remote that they have lost their native ability to discern enemies afar off. They notice the approach of a hawk long before ordinary fowls, and

raise such a din of voice that it is usually deterred from coming very near.

Among people in general there is perhaps a greater need of education concerning hawks and owls than concerning any other group of injurious birds, or even all of them put together. We have only one owl and three or four hawks that are not more beneficial than otherwise. This being the case, we see the folly of setting a bounty on the heads of the whole family, as has been done at various times in several States. Such a bounty takes money from both pockets and throws it to the winds. If farmers knew the troublesome hawks by sight and sound, a little scouting in the spring would enable them to ascertain whether any were breeding in the neighborhood. The sharp-shinned hawk, Cooper's hawk, and the goshawk, the three species that are most injurious, are all easily discovered where they have a nest or intend to build one. Except while migrating, these hawks are mainly confined to a limited area adjacent to their breeding-places, and when these places are known, a steel trap put in the nest may generally be depended upon to secure both birds. If one is careful to shoot the male first, a gun will accomplish the same result.

When a hawk belonging to a species generally beneficial falls into bad habits, there is nothing to be done but to plan for the destruction of that particular bird by the best means available.

The occasional lesser depredations of birds are generally too slight to deserve notice. Orioles take a few peas, grosbeaks and grouse nip off buds from certain trees in winter, two or three of the woodpeckers are fond of the tender inner bark of trees, and sometimes are guilty of tasting apples and oranges. None of these birds can be regulated. If by chance they become unbearable, the only thing to do is to kill them. However, as they are ordinarily useful, such a step should never be taken without full assurance that it is necessary.

CHAPTER XXIV.

ENCOURAGING THE PRESENCE OF BIRDS.

To those who desire the presence of birds, either for the good they do or for love of them, methods for their encouragement will be of interest. Birds select their habitat with reference to food or nesting privileges. Enemies may drive them away. With this much in mind it is not difficult for one acquainted with bird ways to devise means for attracting them. But in the first place it will be well to introduce evidence to show that birds appreciate conveniences when they find them. W. Ward Fowler[1] relates how a neighbor with only two or three acres of land induced fifty-three pairs of birds, exclusive of swallows and martins, to nest there in one month. In the heart of a city the writers know a shrubby garden, closed to cats and boys, which large numbers of birds visit on their migrations. Rare warblers, which many an observer has never seen in that region, visit that spot almost every year.

That birds visit orchards, out-buildings, and door-yards in winter for such odd bits of food as they may obtain, is well known by all who live in the country. The profit that may be derived from feeding them is not so well known. Mr. E. H. Forbush[2] gives an account of how birds were attracted to an old neglected orchard in the town of Medford, Massachusetts. Its situation was favorable, there being a variety of wild fruit-bearing trees and shrubs, and a small piece of woodland consisting chiefly of pines near by. The orchard was in a dilapidated condition at the start, and for three years efforts in its behalf were limited to pruning the trees and protecting them from the ravages of the canker-worms and tent-cater-

[1] A Year with the Birds, p. 118.

[2] In Bulletin No. 2, Mass. Crop Reports, July, 1895.

Photographed from life by Dr. R. W. Shufeldt.

ORCHARD ORIOLE. YOUNG.

pillars which infested the district. These trees revived somewhat under this treatment and began to bear sparingly. The fourth year nothing was done towards destroying the insect pests or in any way interfering with their increase. In the fall of this year immense numbers of the wingless females of the fall canker-worm were seen ascending the trees and depositing their eggs. The eggs of the tent-caterpillar moth were also numerous on the twigs, giving promise of great damage to the foliage of the old orchard on the following summer. In the mean time, however, pieces of meat, bone, and suet were suspended from the trees, and chickadees, nuthatches, woodpeckers, and brown creepers made the orchard their central station. The chickadees, which, of course, were most numerous, became so tame as frequently to alight upon the person having the experiment in charge, and occasionally took food from his hand. Although the food put up for the birds was eaten very freely, it was by no means their sole diet. All of the species were seen to devour quantities of canker-worm eggs, scale-lice, and various hibernating insects injurious to fruit-trees, and these observations were confirmed by the examinations of stomachs. They were also found to feed upon similar insect matter in the neighboring woods.

As spring advanced, the female spring canker-worm moths came up from the ground to deposit their eggs on the apple-trees. Both the moths and their eggs were devoured in great numbers. As insect food increased, the birds paid less attention to the meat. When the breeding season arrived the orchard was mostly deserted by the winter visitors, to be occupied by the summer residents, though both chickadees and woodpeckers nested in the vicinity. Summer exhibited the results of the experiment. While other orchards in the neighborhood were infested by canker-worms and tent-caterpillars, this one was comparatively free from both. That the damage done here by canker-worms was far less than elsewhere must

be attributed to the work of the birds that were fed through the winter. With a single exception this was the only orchard in the vicinity that produced fruit that year.

Winter birds often fare very hard; and even if one has no orchard that needs them, it is an act of kindness to supply them with bits of meat or suet or nuts as may be convenient. At this season, when animal life is at its lowest ebb, it is a joy to see the sprightly little creatures about the house. They become very tame and not infrequently alight upon the hand or enter an open window for tidbits. Driven by hunger, they make forays into town, and thus it is possible for those living in villages or city suburbs to enjoy winter birds if they wish.

Chickadees, nuthatches, and woodpeckers are sure to come if refuse meat or suet is tied to branches of trees, and when once baited they will come to the window-sill for supplies when none are to be had elsewhere, so there is the best possible opportunity to study them. Blue-jays will come to an ear of Indian corn mounted on a stick in the orchard, and by degrees may also be led to join the house-group. Seed-eating birds, such as juncos, tree-sparrows, and redpolls, will come to the door-yard if a bundle of ragweed, buckwheat, a few sunflower heads, or even shallow trays of small seeds are put out.

In order to furnish tempting food for summer birds there must be more elaborate preparations. At that season food is so plentiful that only the best will entice them. Even the best conditions possible will fail to bring them within such close range as is obtained with winter birds. Nevertheless, many birds will come if one will provide for them. About the only sort of food that can be offered with good effect is fruit; but of this there is such a variety both in kind and season that where there is a suitable area there is no difficulty whatever in having an abundance of birds, particularly in spring and during the late summer and autumn.

In the selection of ornamental shrubbery for village and suburban grounds the birds should be remembered. There

are many native shrubs and trees that are decorative and at the same time attractive to birds. More important than summer food is a good site for a nest, and by providing nesting-places birds that care little or nothing for fruit will be attracted.

It is well known that certain birds usually select a particular kind of tree for their nests. For instance, goldfinches breed in maples oftener than in all other trees put together; so does the warbling vireo. Baltimore orioles prefer elms.

A RETREAT FOR WINTER BIRDS.

Brown thrashers select thorny shrubs. Many birds are not particular so long as they have a good cover.

Between food and nest habits, he who would plant trees can select such varieties as to fill his grounds with beauty and song. Let him set a few maples. Vireos will peer and sing in them all summer long, and very often leave their pendent nests as a reminder of summer days, when the branches are bare and cold winds go moaning through them. Goldfinches are sure to come in August. Robins and cedar-birds frequently reside there, and when the pine-finch comes down

from the North on its winter visit, the buds and seeds of the maple are certain to receive a call. The elm, as has been already stated, is the favorite with the Baltimore orioles, but other birds are fond of them too. Purple finches feed upon the opening flower-buds and from their summit pour out their spring-tide of song. Crossbills and goldfinches visit them in June to feast upon their ripening seeds, and when the seeds are fallen, all sorts of seed-eaters will come to the feast. The mountain-ash is often used for an ornamental tree. Its cymes of red berries are quite as attractive to robins and cedar-birds as to us. The dense foliage and symmetrical form of red cedars render them excellent for solitary places. Spring and fall, robins, cedar-birds, purple finches, and even crows, will come for their berries. Bird-cherry and black-cherry and mulberry trees set along the margin of a lot will bring bluebirds, thrushes, robins, and even kingbirds in great numbers, and at the same time form a good background for smaller and more ornamental varieties. A thick clump of evergreen trees in a secluded spot will certainly be occupied at night and become a centre of radiation for matin songs, and in winter crossbills and siskins will come for their seeds. A remote corner planted with stag-horn sumac, barberry, catbrier, and blackberry bushes, and left to itself, will become an asylum for catbirds, brown thrashers, and many other birds which ordinarily nest in tangles. The bright yellow flowers and red berries of the barberry bush, hanging as they do in graceful sprays, are ornamental anywhere. The berries are very persistent, remaining till next year's crop is well started, and are devoured by many birds when other food is scarce. The bay or wax-myrtle bush has an aromatic fragrance in summer, and is not unsightly in quiet corners with its winter load of pallid berries. A small plat devoted to it will flood the grounds with myrtle warblers every fall and thereby indirectly prove a scourge to insects, as these birds prefer an insect diet and turn to bayberries only when insects fail.

A supply of water in shallow receptacles set flush with the turf will fully repay all it costs in entertaining views of avian lavatory operations. Robins love a shower-bath from spray-

MR. CHAPMAN'S BIRD'S-BATH.

ing fountains on hot summer afternoons, and where lawns are kept close-cropped and well watered, robins are always on hand for the earthworms that come to the moist surface. We

DIAGRAM OF BIRD'S-BATH.

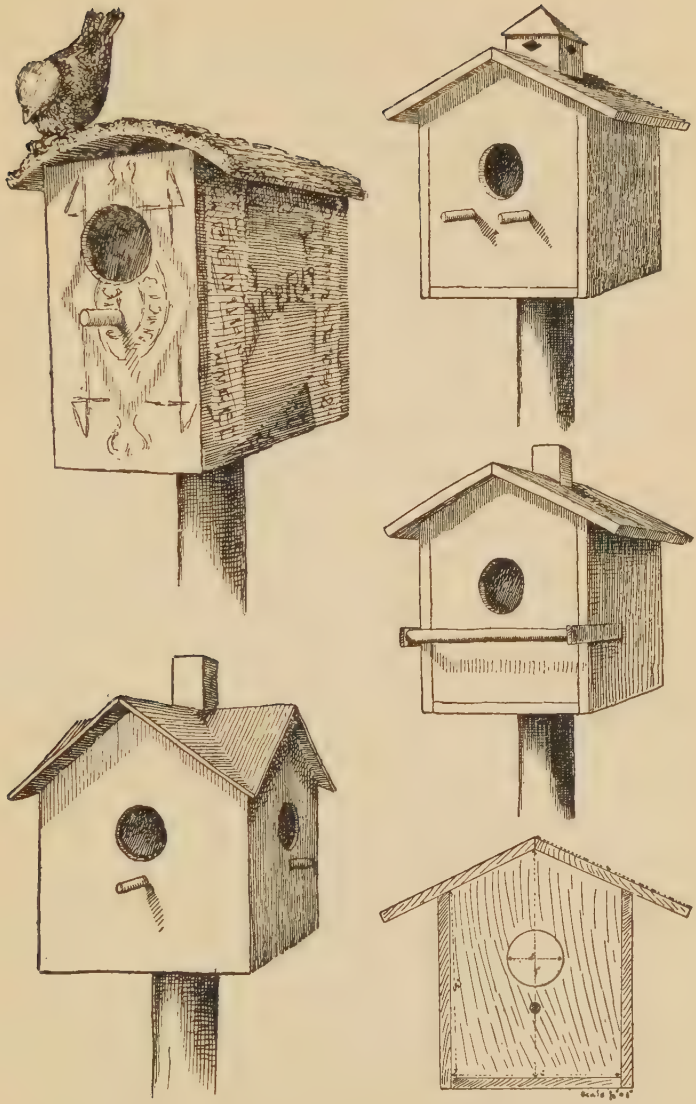
have known robins to come a long distance to get food for their young on a well-watered lawn. Mr. Frank M. Chapman has described[1] an excellent bird's-bath in use on his grounds,

[1] Bird Lore, vol. iii. p. 74.

and illustrated in the accompanying picture. "It is made of bricks and cement and in cross-section resembles the diagram on the previous page.

"Boards may be used to form partitions, which should be filled with earth. The plants introduced were sagittaria, iris, yellow pond-lily, wild rice, duckweed, and water-hyacinth. The pond is filled from a hose and replenished as evaporation requires." This bath was not only a pretty bit of adornment to the lawn, but also proved very attractive as a bathing-place for birds.

In his admirable little leaflet on "The Birds and I," Professor L. H. Bailey writes: "For some kinds of birds we can build houses. Some of the many forms which can be used are shown in the pictures. Any ingenious boy can suggest a dozen other patterns. Although birds may not appreciate architecture, it is well to make the houses neat and tasty by taking pains to have the proportions right. The floor-space in each compartment should be not less than five by six inches, and six by six or six by eight may be better. By cutting the boards in multiples of these numbers, one can easily make a house with several compartments; for there are some birds, as martins, tree-swallows, and pigeons, that like to live in families or colonies. The size of the doorway is important. It should be just large enough to admit the bird. A larger opening not only looks bad, but it exposes the inhabitants to dangers of cats and other enemies. Birds which build in houses, aside from doves and pigeons, are bluebirds, wrens, tree-swallows, martins, and sometimes the chickadee. For the wren and chickadee the opening should be an inch-and-a-half auger-hole, and for the others it should be two inches. Only one opening should be provided for each house or compartment. A perch or door-step should be provided just below each door. It is here that the birds often stop to arrange their toilets; and when the mistress is busy with domestic affairs in-doors, the male bird often sits outside



PROFESSOR BAILEY'S SUGGESTIONS FOR BIRD-HOUSES.

(After Cornell University Experiment Station.)

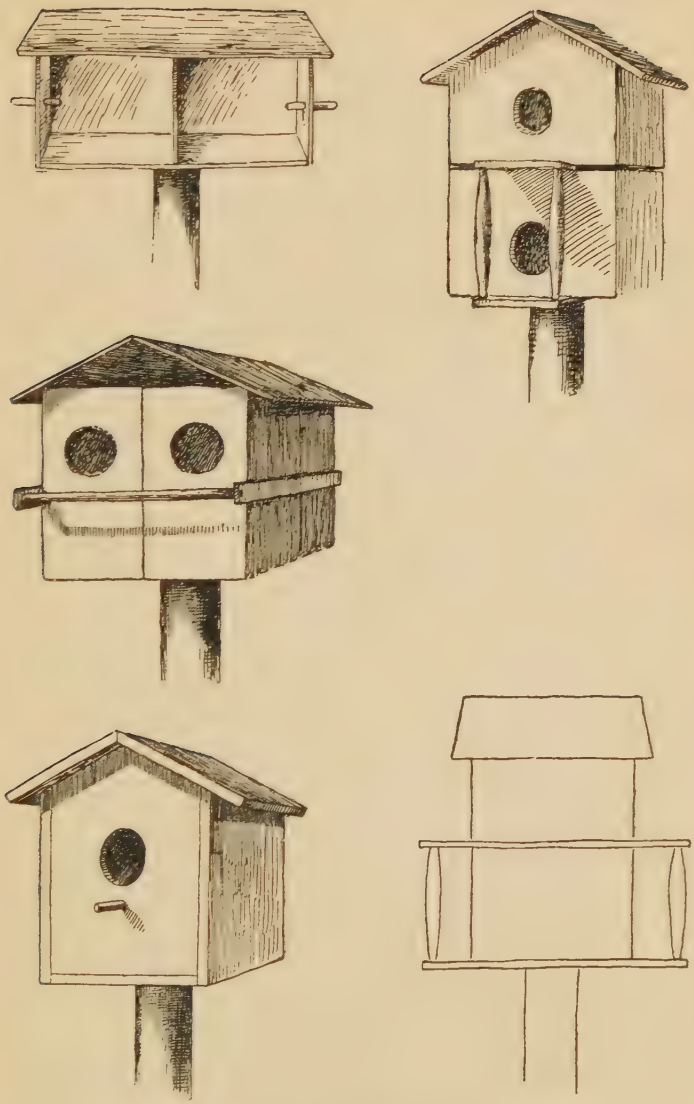
and entertains her with the latest neighborhood gossip. These houses should be placed on poles or on buildings in somewhat secluded places. Martins and tree-swallows like to build their nests twenty-five feet or more above the ground, but the other birds usually prefer an elevation less than twelve feet. Newly-made houses, and particularly newly-painted ones, do not often attract the birds."

Bird-houses should be protected from cats. If the houses are in trees, several rings of barbed wire may run around the tree spirally, near together, and held in place by staples. If the houses are on poles which the cats can climb, the same device may be used, or a horizontal shelf of tin may be fastened below the house.

One of the commonest difficulties with the use of bird-houses is that they are taken possession of by English sparrows to the exclusion of the native birds. For bluebirds at least this may sometimes be avoided by the use of the sparrow-proof houses described and figured in *Bird Lore*, by Mr. D. R. Geery, of Greenwich, Connecticut. "When designed for bluebirds they should be suspended from a limb ten or twelve feet from the ground, in such a manner as to allow them to swing slightly. It may happen that the sparrows will go to these houses and even commence to build; but as soon as they find that they swing and are not firm, they will abandon them entirely. Wren-boxes should be stationary, with an opening not much larger than a twenty-five-cent piece, and placed so as to be well shaded most of the day." Other observers have reported, however, that sparrows will occupy such swinging houses.

Helpful suggestions upon this phase of the subject may also be gotten from an excellent little English book by John R. B. Masefield, entitled "Wild Bird Protection," and from Neltje Blanchan's "How to Attract the Birds."

An admirable idea has been carried out in the Manual Training Department of the Worcester, Massachusetts, schools



PROFESSOR BAILEY'S SUGGESTIONS FOR BIRD-HOUSES.

(After Cornell University Experiment Station.)

in making the construction of attractive bird-houses a regular part of the course in woodwork. Pictures of these houses are shown in the suggestive bulletin by Professor C. F. Hodge, entitled "Our Birds."

There is no easier way of enticing birds in summer than by putting up boxes or similar artificial retreats for nests. Bluebirds, wrens, tree-swallows, and martins have come to be so largely dependent upon human thoughtfulness that there need be no apprehension of failure on this score. Almost anything that is hollow and has a hole for an entrance will do. A gourd or a small box made from weather-worn boards hung in a tree or put upon a pole, will satisfy the birds quite as well as more expensive domiciles. A narrow strip of board nailed along the eaves of the stable will offer a desirable nesting-site for cliff-swallows. A shelf beneath an overhanging part of a building is likely to be occupied by a phœbe's nest. Barn-swallows will locate on the rafters of out-buildings if given access.

Birds may be further favored in the way of procuring material for their nests. In dry seasons such birds as robins, phœbes, and swallows often have to go a long way for mud which forms the framework of their nests. A peck of clay put in an old pan or box, or even spread out in the road, and kept moist by the application of a little water two or three times a day, is of great assistance to them.

Orioles, kingbirds, and cedar-birds are always glad to come into the yard for yarn put out on the trees or fence for their use. Vireos will come for strips of birch-bark and sometimes for bits of newspaper; even feathers left on the ground where they may be readily seen are picked up by swallows and used for lining their nests. After one knows what birds' nests are made of, he has only to supply suitable material,—the birds will come. Birds that employ woolly material may be induced to construct very gay homes by supplying them with colored worsteds. It would probably be well to cut all strings

into lengths of a foot or so, to avoid some of the bird tragedies which have lately been recorded.

Finally, birds are encouraged in the same ratio as their enemies are discouraged. In the country, hawks, crows, jays, and squirrels are usually their worst foes. In or near town, boys and cats give most trouble. Eternal vigilance will go a long way, but it will not prevent the ravages of cats. If one wishes to keep cats from marauding on his grounds, he must surround them with a cat-proof fence; there is no other way. Such a fence may be constructed of woven wire such as is used for hen-yards. It should be not less than six feet high, and at the top there should be an excess of about two feet of the netting left to hang loosely outward nearly horizontally, to head off adventurous climbers. Entrance may be made by means of doors or gates covered with netting, made to swing outward and closed by spring hinges.

Mr. William Brewster, of Cambridge, Massachusetts, has a fence of this kind around his grounds that has proved a complete success. Mr. Brewster informs us that failure to close a door properly admits perhaps one cat a year, but none ever scales the fence from the outside.

The presence of birds near at hand gives admirable opportunities for hunting with a camera, that merciful sport which is rapidly taking the place of the more cruel hunting with a gun. The improved lenses and cameras now available for this work render it a comparatively simple matter to get pictures of birds that shall be a joy to the possessor as well as to all beholders.

APPENDIX I.

THE BIRD LAW OF THE AMERICAN ORNITHOLOGISTS' UNION.

An Act for the Protection of Birds and their Nests and Eggs.

SECTION 1.—No person shall, within the State of
kill or catch or have in his or her possession, living or dead, any wild bird other than a game-bird, nor shall purchase, offer, or expose for sale any such wild bird after it has been killed or caught. No part of the plumage, skin, or body of any bird protected by this section shall be sold or had in possession for sale. For the purposes of this act the following only shall be considered game-birds: The *Anatidæ*, commonly known as swans, geese, brant, river- and sea-ducks; the *Rallidæ*, commonly known as rails, coots, mud-hens, and gallinules; the *Limicolæ*, commonly known as shore-birds, plover, surf-birds, snipe, woodcock, sand-pipers, tattlers, and curlews; the *Gallinæ*, commonly known as wild turkeys, grouse, prairie-chickens, pheasants, partridges, and quails.

SEC. 2.—No person shall, within the State of
take or needlessly destroy the nest or the eggs of any wild bird nor shall have such nest or the eggs in his or her possession.

SEC. 3.—Any person who violates any of the provisions of this act shall be guilty of a misdemeanor, and shall be liable to a fine of five dollars for each offence, and an additional fine of five dollars for each bird, living or dead, or part of bird, or nest and eggs possessed in violation of this act, or to imprisonment for ten days, or both, at the discretion of the court.

SEC. 4.—Sections 1, 2, and 3 of this act shall not apply to any person holding a certificate giving the right to take birds and their nests and eggs for scientific purposes, as provided for in Section 5 of this act.

SEC. 5.—Certificates may be granted by [here follow the names of the persons, if any, duly authorized by this act to grant such certificates], or by any incorporated society of natural history

in the State, through such persons or officers as said society may designate, to any properly accredited person of the age of fifteen years or upward, permitting the holder thereof to collect birds, their nests or eggs, for strictly scientific purposes only. In order to obtain such certificate the applicant for the same must present to the person or persons having the power to grant said certificate written testimonials from two well-known scientific men, certifying to the good character and fitness of said applicant to be intrusted with such privilege; must pay to said persons or officers one dollar to defray the necessary expenses attending the granting of such certificates; and must file with said persons or officers a properly executed bond in the sum of two hundred dollars, signed by two responsible citizens of the State as sureties. This bond shall be forfeited to the State and the certificate become void upon proof that the holder of such a certificate has killed any bird, or taken the nest or eggs of any bird, for other than the purposes named in Sections 4 and 5 of this act, and shall be further subject for each such offence to the penalties provided therefor in Section 3 of this act.

SEC. 6.—The certificates authorized by this act shall be in force for one year only from the date of their issue, and shall not be transferable.

SEC. 7.—The English or European house-sparrow (*Passer domesticus*) is not included among the birds protected by this act.

SEC. 8.—All acts or parts of acts heretofore passed, inconsistent with or contrary to the provisions of this act, are hereby repealed.

SEC. 9.—This act shall take effect upon its passage.

REMARKS.

The accompanying law is calculated to protect our birds as effectually as any legislation can, and it is desirable, if possible, to obtain its passage as it stands. It is, however, a well-known fact that in many of our States the act would not receive favorable consideration unless modified in several particulars. We offer the following suggestions regarding revision when it is unavoidable:

1. *Game-Birds.*—In many States doves are universally classed as game-birds, and where the game laws cover their protection during a closed season they may be so classed in Section 1 if necessary.

Reed-birds and blackbirds may have to be treated in the same way in several States. Robins, flickers, and meadow-larks, however, should not be permitted to be classed as game.

2. *Cage Birds.*—There is nothing in the law to prevent the keeping of foreign cage birds, as canaries, etc.

To keep *native* birds alive for study, etc., a certificate must be secured as per Section 5. This is necessary to prevent traffic in live birds.

3. Other birds which may have to be excluded from protection:

Hawks and Owls.—The prejudice against these birds is very strong, while the argument in their favor is well known and conclusive. They should be protected if possible. If nothing better can be done, effect a compromise by excluding Cooper's hawk, goshawk, sharp-shinned hawk, and great horned owl, and protect the rest. Crows may have to be denied protection; there is about as much evidence for as against them, however. Shrikes, herons, gulls, and terns should by all means be protected.

4. Where it is absolutely necessary to exclude any birds from protection they may be added to Section 7, so as not to alter the main text.

5. On no account omit Sections 4, 5, and 6, as has been done in some of the present laws.

With the restrictions placed upon holders of certificates there is no danger of improper persons obtaining them. A small number of birds are required for scientific purposes, and provision should be made for obtaining them as much as for shooting game-birds. The fee should be abolished, if possible, and should on no account be more than one dollar. The age limit should, moreover, *not* be raised above fifteen years.

APPENDIX II.

THE LACEY BIRD LAW.

An Act to enlarge the Powers of the Department of Agriculture, prohibit the Transportation by Interstate Commerce of Game killed in Violation of Local Laws, and for other Purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the duties and powers of the Department of Agriculture are hereby enlarged so as to include the preservation, distribution, introduction, and restoration of game-birds and other wild birds. The Secretary of Agriculture is hereby authorized to adopt such measures as may be necessary to carry out the purposes of this act and to purchase such game-birds and other wild birds as may be required therefor, subject, however, to the laws of the various States and Territories. The object and purpose of this act is to aid in the restoration of such birds in those parts of the United States adapted thereto where the same have become scarce or extinct, and also to regulate the introduction of American or foreign birds or animals in localities where they have not heretofore existed.

The Secretary of Agriculture shall from time to time collect and publish useful information as to the propagation, uses, and preservation of such birds.

And the Secretary of Agriculture shall make and publish all needful rules and regulations for carrying out the purposes of this act, and shall expend for said purposes such sums as Congress may appropriate therefor.

SEC. 2.—That it shall be unlawful for any person or persons to import into the United States any foreign wild animal or bird except under special permit from the United States Department of Agriculture: *Provided*, That nothing in this section shall restrict the importation of natural history specimens for museums or scientific collections or the importation of certain cage

birds, such as domesticated canaries, parrots, or such other species as the Secretary of Agriculture may designate.

The importation of the mongoose, the so-called "flying-foxes" or fruit bats, the English sparrow, the starling, or such other birds or animals as the Secretary of Agriculture may from time to time declare injurious to the interest of agriculture or horticulture is hereby prohibited, and such species upon arrival at any of the ports of the United States shall be destroyed or returned at the expense of the owner. The Secretary of the Treasury is hereby authorized to make regulations for carrying into effect the provisions of this section.

SEC. 3.—That it shall be unlawful for any person or persons to deliver to any common carrier or for any common carrier to transport from one State or Territory to another State or Territory, or from the District of Columbia or Alaska to any State or Territory, or from any State or Territory to the District of Columbia or Alaska, any foreign animals or birds the importation of which is prohibited, or the dead bodies or parts thereof of any wild animals or birds where such animals or birds have been killed in violation of the laws of the State, Territory, or District in which the same were killed: *Provided,* That nothing herein shall prevent the transportation of any dead birds or animals killed during the season when the same may be lawfully captured and the export of which is not prohibited by law in the State, Territory, or District in which the same are killed.

SEC. 4.—That all packages containing such dead animals, birds, or parts thereof, when shipped by interstate commerce, as provided in Section 1 of this act, shall be plainly and clearly marked, so that the name and address of the shipper and the nature of the contents may be readily ascertained on inspection of the outside of such packages. For each evasion or violation of this act the shipper shall, upon conviction, pay a fine of not exceeding two hundred dollars; and the consignee knowingly receiving such articles so shipped and transported in violation of this act shall, upon conviction, pay a fine of not exceeding two hundred dollars; and the carrier knowingly carrying or transporting the same shall, upon conviction, pay a fine of not exceeding two hundred dollars.

SEC. 5.—That all dead bodies, or parts thereof, of any foreign game-animals or game- or song-birds, the importation of which is prohibited, or the dead bodies or parts thereof of any wild game-animals or game- or song-birds transported into any State or Territory, or remaining therein for use, consumption, sale, or storage therein, shall, upon arrival in such State or Territory, be subject to the operation and effect of the laws of such State or Territory enacted in the exercise of its police powers, to the same extent and in the same manner as though such animals and birds had been produced in such State or Territory, and shall not be exempt therefrom by reason of being introduced therein in original packages or otherwise. This act shall not prevent the importation, transportation, or sale of birds or bird plumage manufactured from the feathers of barn-yard fowl.

Approved May 25, 1900.

APPENDIX III.

SOME FUNDAMENTAL PRINCIPLES OF BIRD LAWS.

BY T. S. PALMER.

ADEQUATE laws necessarily form the foundation of effective bird protection. But it is not enough merely to enact laws: they must be enforced and doubtful points must be settled by the courts. The bird laws of the United States, usually called game laws, are of two kinds (*a*) State or local laws and (*b*) Federal laws.

State laws prescribe the kinds of birds which may or may not be killed, the time and manner in which they may be taken, and the purpose for which they may be captured. Thus the Illinois game law defines game-birds and prohibits the killing of other birds at any time. In providing for game it fixes a definite season for shooting quail and ducks, but forbids the killing of ducks at any season from a sail-boat, with a swivel gun, or after sunset; furthermore it declares that it shall be unlawful to capture quail in the State for sale or ship to other States except under license. In all these matters the State is supreme and violations of its laws are tried in the State courts.

The Federal law, commonly known as the Lacey Act, or the Act of May 25, 1900, deals merely with the shipment of birds from one State to another and the importation of birds from foreign countries. It is general in its provisions and does not mention special birds, but, nevertheless, supplements the State laws very effectually. Thus if a State prohibits the killing of any particular bird, the shipment of the bird out of that State is an offence under the Federal law, and the shipper, carrier, and consignee, each or all, may be prosecuted in the United States courts.

Some of the principles on which these laws are based may be stated very simply as follows:

(*a*) STATE LAWS.

1. All wild birds are the property of the State, hence:

2. Killing birds is a privilege, not a right.

3. State ownership of birds carries with it the right to impose restrictions, hence:

4. Birds may be captured, possessed, transported, bought, or sold only under such conditions as the State prescribes.

5. Land-owners have no more right to kill birds out of season than other persons, unless the law specifically grants this privilege.

(*b*) FEDERAL LAW.

6. Birds are protected by the Federal law only when shipped from or into a State which protects them by a local law.

7. Birds killed or shipped contrary to law in any State cannot lawfully be transported to other States.

8. Birds brought into a State become subject to its laws in the same manner and to the same extent as birds produced in that State.

9. Packages of birds shipped from one State to another must be marked so as to show the name of the shipper and the nature of the contents.

10. Foreign birds can be imported into the United States only under permit from the United States Department of Agriculture, and birds declared injurious by the Secretary of Agriculture cannot be imported into the United States or shipped from one State to another.

Simple as all these propositions may seem, they have been the cause of much discussion. Most of them, however, have been passed upon by the higher courts and are no longer open to question. The right of the crown to all wild game was established in England years ago, and the State ownership of game now clearly stated in the laws of Colorado, Illinois, Michigan, Minnesota, Texas, and Wisconsin is an inheritance from the English common law. The Supreme Court of the United States has upheld this claim as well as the right of the State to prohibit killing game for sale (125 U. S., 465) or export (Geer *vs.* Connecticut, 161 U. S., 519).

Possession of birds out of season was long regarded merely

as evidence of illegal killing, but is now made an offence punishable by fine in several States. The right of a State to make laws regarding birds imported from other States has been vigorously contested and has been variously decided by the courts, but the question has now been practically set at rest by the passage of the Lacey Act. Some States have hesitated to encroach upon the rights of the individual, as shown by the exception in favor of land-owners in the section of the Delaware law relating to insectivorous birds, and also by the provisions in the laws of Illinois, Kansas, Kentucky, Louisiana, Ohio, and South Carolina which permit a person to kill birds found destroying fruit on his own premises. On the other hand, Massachusetts declares that game artificially reared shall be the exclusive property of the person raising it, but forbids the owner to sell it for food during close seasons. Illinois exacts a ten-dollar hunting license from non-residents, even though they lease or own a game preserve within the State, and Wyoming, in the famous "Race Horse case," carried up to the Supreme Court in 1896, has successfully maintained her right to compel Indians to obey her game laws (163 U. S., 504).

During the last fifty years the sentiment in favor of bird protection has developed rapidly. Many laws have been enacted, amended, and sustained by the courts. That these laws are still imperfect is partly the result of carelessness and partly of strong opposition due to ignorance or selfishness. Our game laws, unlike those of Europe, are maintained for the good of the people as a whole, not for the benefit of any one class, and their enforcement depends very largely on a general appreciation of the principles upon which they are based.—*Bird Lore,* vol. iii., pages 79-81.

APPENDIX IV.

A PARTIAL BIBLIOGRAPHY OF THE ECONOMIC RELATIONS OF NORTH AMERICAN BIRDS.[1]

BY CLARENCE M. WEED.

THE importance of birds as checks upon the undue increase of noxious insects has long been recognized by observing men scattered here and there throughout the United States. But a general appreciation of the value of these feathered allies is of comparatively recent development, and in some regions they are still unappreciated.

The literature which has led to a wider knowledge of the value of birds has been scattered through many publications, much of which is inaccessible to the general reader, and some of it difficult to obtain even by the specialist. In the following pages I have attempted to bring together a bibliographic list of the more important articles treating of the economic relations of our birds. In compiling it I have had the help of Messrs. A. F. Conradi, W. F. Fiske, and R. A. Cushman, while assistants in the entomological department of this station. For a number of citations of articles in *Forest and Stream* I am indebted to the pages of *The Auk*, while a few others have been gleaned from various other sources. It has been impracticable to include citations of the great mass of literature treating specifically of game-birds, or their acclimation and domestication, as well as of the thousands of references to the English sparrow, and of the many general bird books of recent years.

1854. GORGAS, JOHN. Importation of Skylarks. United States Patent Office, Agricultural Report, 1853, pages 70-71.

Account of an importation of skylarks into America in the spring of 1853.

---

[1] Reprinted, with corrections and additions, from Technical Bulletin No. 5, New Hampshire College Agricultural Experiment Station.

1854. Wolford, H. L. On the Importation and Protection of Useful Birds. United States Patent Office, Agricultural Report, Part II., 1853, pages 71-74.

A strong recommendation for the importation of immense numbers of European song and insectivorous birds into America.

1855. Le Baron, William. Observations upon some of the Birds of Illinois most interesting to the Agriculturist. Transactions Illinois Agricultural Society, 1853-54, vol. i., pages 559-565.

A general discussion, with especial reference to the insectivorous birds of Illinois.

1859. Jenks, J. W. P. The Food of the Robin. Transactions Massachusetts Horticultural Society, 1859.

Critical study of stomach contents of many specimens.

1859. Treadwell, D. The Food of Young Robins. Proceedings Boston Society of Natural History, vol. vi., pages 396-399.

Amount of food eaten by young robins.

1859. Kirkpatrick, John. Rapacious Birds of Ohio. Ohio Agricultural Report for 1858, pages 341-383.

1860. Kirkpatrick, John. Birds of Ohio. *Ohio Farmer* (Cleveland), 1858-1860.

A series of articles running through three years.

1861. Collins, W. O. Report of Senate Select Committee upon Senate Bill No. 12, "For the Protection of Birds and Game." Fifteenth Annual Report Ohio State Board of Agriculture for 1860 (1861), pages 381-390.

Facts in the natural history of Ohio birds, with recommendations for legislative action.

1861. (Harris, S. D., Editor.) Field Notes, I., 1861, page 65.

Note on the introduction of the English skylark at Columbus, in 1851.

1861. Wells, D. A. On the Feeding and Growth of the American Robin. United States Patent Office, Report on Agriculture, 1860, pages 88-89.

Abstract of an article by Professor Treadwell, of Cambridge, Massachusetts, directed to the Boston Society of Natural History, and containing a detailed account of the food required by two young robins captured when about half grown.

1862. Flagg, Wilson. Utility of Birds. Massachusetts Agricultural Report, 1861, pages 70-78.

Long essay on the economic value of birds, with numerous notes on food habits of certain species, some of them from original observations.

1864. Michener, E. Agricultural Ornithology. Insectivorous Birds of Chester County, Pennsylvania. United States Department of Agriculture, Report, 1863, pages 287-307.

The value of birds to the agricultural interests discussed, and followed by a list of the birds of Chester County, Pennsylvania, with the exception of the water species. Brief notes on the food and habits of each bird are given.

1864. Samuels, E. A. Mammalogy and Ornithology of New England with special reference to Agricultural Economy. United States Department of Agriculture, Report, 1863, pages 265-286.

Outlines of the classification of mammals, birds, and insects, with brief notes on the economic importance of each order from an agricultural stand-point. Also a more general discussion of the relations between the birds and mammals and the farmer, and the causes which tend to alter them.

1865. Dodge, J. R. Birds and Bird Laws. United States Department of Agriculture, Report, 1864, page 431.

Treats of the uses of birds, the necessity of a balance in animal production, value of birds as insect destroyers; the refutation of false charges against them and manner of protecting them; and gives in conclusion a digest of the bird and game laws then existing in most of the Eastern and Central States.

1865. Elliot, D. G. The "Game-Birds" of the United States. United States Department of Agriculture, Report, 1864, pages 356-385.

An introduction defining the phrase "game-bird" as here used, followed by more or less lengthy discussions of the following species which he classifies under that head: Wild turkey, Mexican wild turkey, ocellated wild turkey, cock of the plains, ruffed grouse, Sabine's grouse, allied grouse, prairie hen, sharp-tailed grouse, Arctic sharp-tailed grouse, dusky grouse, Richardson's grouse, spruce grouse, Franklin's grouse, white-tailed ptarmigan, willow ptarmigan, Virginian partridge, Texan partridge, plumed partridge, California partridge, Gambel's partridge, scaled partridge, Massena partridge, woodcock, Wilson's or English snipe, and wild pigeon.

1866. Samuels, E. A. The Agricultural Value of Birds. Massachusetts Agricultural Report, 1865-1866, pages 94-117.

An address on the value of the different groups of birds, with general discussion and citation of examples at home and abroad.

1866. Glover, Townend. Report of the Entomologist. Report of the Department of Agriculture, 1865, pages 36-45.

A general synopsis of the insectivorous birds of North America, with account of the examination of stomachs of many of them. Included in the report of the government entomologist for 1865.

1867. Walsh, Benjamin D. Birds *vs.* Insects. *Practical Entomologist,* vol. ii., pages 44-47.

An important article showing the injury of birds to fruit, and contending that they do much damage by destroying predaceous and parasitic insects.

1868. Samuels, E. A. Value of Birds on the Farm. United States Department of Agriculture, Report, 1867, pages 201-208.

Notes on the economic importance of birds, with accounts of the examination of stomachs of the robin, various species of woodpeckers, cuckoos, crows, and jays; nearly all of the notes are apparently original.

1869. Turnbull, William P. The Birds of East Pennsylvania and New Jersey. Philadelphia, Henry Grambo & Co., pages i.-vii., 5-50.

On pages 48-50 there is a discussion of "Birds which have disappeared."

1870. Le Baron, William. Do Birds do More Good than Harm? No. I., *Prairie Farmer*, March 12, 1870, vol. xli., page 74; No. II., *Ibid.*, March 19, 1870, page 82; No. III., *Ibid.*, April 2, 1870. Summary in Seventeenth Report of the State Entomologist of Illinois, Appendix, pages 6-7.

First article considers injuries done by birds in general. The second considers certain common species. The third considers birds as essential to keeping up the balance of nature.

1870. Le Baron, William. Insectivorous Habits of the Prairie Lark (*Alauda alpestris*). *American Entomologist*, April, 1870, vol. ii., page 177.

Feeds on cutworms as well as grain.

1871. Glover, T. Report of the Entomologist. Report of the United States Department of Agriculture, 1870, pages 90-91.

Note on the economic value of birds in general, and on the introduction of the English sparrow in particular, included in the report on entomology.

1872. Lockwood, Rev. Samuel. The Baltimore Oriole and Carpenter Bee. *American Naturalist*, vol. ii., pages 721-724.

Oriole removes head of bee and empties honey-sack.

1872. Palmer, Frank H. The Utility of Birds to Agriculture. Massachusetts Agricultural Report, 1870-1872, pages 107-120.

An essay on economic importance of birds, special reference being made to some thirty New England species.

1873. Perkins, G. H. Birds in their Relation to Agriculture. Vermont Agricultural Report, 1872, pages 316-337.

A paper read before the Vermont State Board of Agriculture, on the economic relations of birds. Abstract in the report of the United States Department of Agriculture, 1873, page 476.

1874. Bailey, L. H., Jr. Birds. Third Annual Report Secretary State Pomological Society of Michigan for 1873, pages 127-128.

Insect-feeding habits of several common singing birds of Michigan.

1874. Boyce, Caroline. The Robin. *American Naturalist,* vol. viii., pages 203-208.

Habits, food, nesting, broods, time of brooding.

1874. Lang, J. W. The Value of Insect-Eating Birds. New Hampshire Agricultural Report, 1873, vol. iii., pages 297-314.

Introduction, followed by a synopsis of families with chief characteristics; a discussion on the food of birds, with some apparently new data on stomach contents in a few instances, and concluding remarks on the necessity of a proper balance, the usefulness of birds in general, and a plea for their protection.

1874. Le Baron, William. The Bird Question. Transactions Illinois State Horticultural Society, 1873, vol. vii., pages 311-319.

Discussion of the economic importance of birds.

1875. Palmer, Frank H. Insect-Eating Birds, the Farmer's Best Friends. Boston, Massachusetts, Society Prevention of Cruelty to Animals, 1875.

A prize essay, and an admirable discussion.

1875. Wheaton, J. M. The Food of Birds as Related to Agriculture. Ohio Agricultural Report for 1874 (1875), pages 561-578 (September, 1875). Also reprint, repaged, but otherwise unchanged, pages 1-18.

"This is in effect a corrected and completed list of the birds of Ohio, briefly annotated, and with the general food regimen of each family given; being a well-conceived essay of much practical utility." Coues, Bibliographical Appendix, Birds of Colorado Valley, 1878, page 716.

1876. Coues, Elliott. The Destruction of Birds by Telegraph Wires. *American Naturalist,* vol. x., pages 734-736.

Many hundreds of thousands of birds killed. Instances cited.

1877. Allen, J. A. Destruction of Birds in the United States. *Popular Science Monthly,* vol. x., page 636.

Review of article by Mr. Allen in *Penn Monthly,* condemning the wholesale slaughter of the herons in Florida.

1877. Caton, J. W. The Wild Turkey and its Domestication. *American Naturalist,* vol. xi., pages 321-330.

The young; effects of domestication; characters of sexes; food; three principles of domestication.

1877. Calvin, Samuel. On Changes of Habit among Woodpeckers. *American Naturalist,* vol. xi., pages 471-472.

Struggle for life among bark-searching insects during recent geologic ages, severe, etc.

1878. Aughey, Samuel. Notes on the Nature of the Food of the Birds of Nebraska. United States Entomological Commission, First Report, Appendix II.

A very important paper showing the relation of birds to outbreaks of the Rocky Mountain locust.

1878. Lockwood, Samuel. The Night Herons and their Exodus. *American Naturalist,* vol. xii., pages 29-35.

The quantity of food consumed by these birds.

1878. Lyle, David Alexander. The Robins' Food. *American Naturalist,* vol. xii., pages 448-453.

Habits, quality, quantity.

1878. Williston, S. W. The Prairie Dog, Owl, and Rattlesnake. *American Naturalist,* vol. xii., page 207.

The shore-lark part of food of the owl.

1879. Fisher, A. K. Small Birds Caught by the Burdock. *American Naturalist,* vol. x., page 239.

Humming-bird, yellow-bird, and yellow-rumped warbler caught by burs of burdock.

1880. Brewer, T. M. The Value of Birds. Transactions Illinois State Horticultural Society, 1879, vol. xiii., pages 173-178.

Reprint of an address delivered before the Hingham (Mass.) Agricultural and Horticultural Society, July 19, 1869, on the economic importance of birds.

1880. Cummings, A. L. Horticultural Ornithology. Transactions Illinois State Horticultural Society, 1879, vol. xiii., pages 295-298.

Discussion of the economic relations of certain of our native birds.

1880. Forbes, S. A. The Food of Birds. Transactions Illinois State Horticultural Society, 1879, vol. xiii., pages 120-172.

Discussion of the economic value of birds, followed by detailed account of the feeding habits of the robin, catbird, brown thrush, wood-thrush, Alice's thrush, and Swainson's thrush; followed by a detailed account of the stomach contents of these birds.

1880. Forbes, S. A. The Food of Birds. Bulletin Illinois State Laboratory Natural History, vol. i., pages 80-148.

A general introduction discussing the necessity of a knowledge of bird food and methods of study, with extended records of studies of food of the thrushes and stone-chats.

1880. Forbes, S. A. On Some Interactions of Organisms. Bulletin Illinois State Laboratory Natural History, vol. i., pages 3-17.

A general discussion of the food relations of animals, with especial reference to birds and insects.

1880. Forbes, S. A. Notes on Insectivorous Coleoptera. Bulletin Illinois State Laboratory Natural History, vol. i., pages 153-160.

Feeding habits of ground-beetles, with discussion of relation to birds.

1880. Perris, Edouard. Birds *vs.* Insects. *American Entomologist,* vol. iii., pages 69-72, 96-100.

A translation by S. A. Forbes of an important paper making arguments similar to those of Walsh in 1867.

1880. Webster, F. M. Notes upon the Food of Predaceous Beetles. Bulletin Illinois State Laboratory Natural History, vol. i., pages 149-152.

Observation on food habits of ground-beetles and others that birds feed upon.

1881. Aldrich, Charles. Value of the House-Wren as an Insect Destroyer. *American Naturalist,* vol. xv., page 318.

Hardiness, sociability, love of locality, and wonderful fecundity render it one of the most valuable of our insectivorous birds.

1881. Bumpus, H. C. The Habits of the Yellow-Bellied Woodpecker. *American Naturalist,* vol. xv., page 738.

A proof that these birds are sap-eaters, if not also bark-eaters.

1881. Forbes, S. A. Supplementary Report on the Food of the Thrush Family. Transactions Illinois State Horticultural Society, 1880, vol. xiv., pages 106-126.

Comparison between earlier and more recent tables of the food of the thrushes of Illinois (Transactions Illinois State Horticultural Society, 1879, vol. xiii., pages 120-172), with additional notes on the food of this family, followed by a detailed account on the food of the bluebird.

1881. Lockwood, Samuel. The Eastern Snow-Bird. *American Naturalist,* vol. xv., page 524.

Note on exportation as a trade.

1882. Allen, C. A. The Birds. New Hampshire Agricultural Report, 1881, pages 269-282.

Discussions on the following topics: Useful birds; warblers, fly-catchers, swallows, creepers, woodpeckers, and thrushes. Singular habits of birds; the cow bunting. Birds injurious to farmers, a list comprising the crow and blue jay, species of hawks (Cooper's, duck, pigeon, sparrow, sharp-shinned, gos-, red-tailed, red-shouldered), and two species of owls (horned and eared). Plumage birds; descriptions of some of the brightest-colored birds occurring in New Hampshire.

1882. Forbes, S. A. The Ornitholigical Balance Wheel. Transactions Illinois State Horticultural Society, 1881, new series, vol. xv., pages 120-131. Extract Report State Horticultural Society, Michigan. 1881, page 203. *Pacific Rural Press,* January 21, 1882. *Shawnee News,* February 13, 1882.

Relations of birds to army-worms, canker-worms, and chinch-bugs.

1882. King, F. H. Economic Relations of Wisconsin Birds. Geological Survey of Wisconsin, vol. i., pages 441-610.

An elaborate report giving results of investigations of many birds.

1882. Slade, Elisha. Food of the Nestlings of *Turdus migratorius*. *American Naturalist,* vol. xvi., page 1007.

Animal food—insects in all stages of development—later broods, all kinds of fruits growing in the garden.

1882. Stearns, R. E. C. Wild Geese as Pests. *American Naturalist,* vol. xvi., page 326.

Pull up the young wheat in the grain-fields of the Upper San Joaquin Valley, California.

1882. Wheaton, J. M. Report on the Birds of Ohio. Geological Survey of Ohio, vol. iv., pages 187-628.

An elaborate report, with many references to economic relations. First published separately in 1879.

1883. Forbes, S. A. The Food Relations of the Carabidæ and the Coccinellidæ. Bulletin Illinois State Laboratory Natural History, vol. i., No. 6, pages 33-64.

Record of studies with reference to food of ground-beetles and lady-beetles, and their relations to birds.

1883. Forbes, S. A. The Regulative Action of Birds upon Insect Oscillations. Bulletin Illinois State Laboratory Natural History, vol. i., No. 6, pages 3-32.

Results of investigation of food of birds in an orchard infested with canker-worms.

1883. Forbes, S. A. Birds in Relation to Agriculture. Stoddard's Encyclopedia Americana, vol. i., pages 131-134.

A short discussion.

1883. Slade, Elisha. Kingbirds Feeding their Young upon Fruits. *American Naturalist,* vol. xvii., page 887.

The parents fed their young on fruit of honeysuckle, and when nestlings were able to fly they were conducted to bush and persisted until the plant was stripped.

1883. Stearns, W. A. The Utility of Birds in Agriculture. New Hampshire Agricultural Report, 1882, pages 219-238.

An address on the economic importance of birds, treating of classification, utility of birds in general, and certain species (blue jay, Baltimore oriole, chickadee, white- and red-bellied nuthatch, etc.) in particular, and the utility of birds in migration.

1883. Storer, F. H. A Caterpillar-eating Henhawk. (*Buteo pennsylvanicus.*) *Science,* vol. i., page 168.

1883. Somers, J. On the Winter Food of the Partridge and on Partridge Poisoning. Proceedings and Transactions Nova Scotian Institute Natural Science, vol. vi., Part 1, pages 78-84.

1883. Van Oken, A. G. The Hairy Woodpecker. *American Naturalist,* vol. xvii., pages 511-513.

Reference to economic value.

1884. Aldrich, Charles. Notes on the Redwing Blackbird. *American Naturalist,* 1884, vol. xviii., pages 309, 310.

On its nesting habits and decrease in numbers through the reclamation of wet lands.

1884. Birds and Electric Light. *Forest and Stream,* vol. xxii., page 424.

Extract from the Winona (Minnesota) *Republican* of May 23, 1884, giving account of the destruction of large numbers of birds killed by striking against electric lights during two nights, May 20 and 21, at Winona, Minnesota.

1884. Byrne. Fruit-eating Birds. *Forest and Stream,* vol. xxii., page 24.

Arraignment of the robin and catbird.

1884. Cahoon, J. C. Protecting Song-Birds. *Forest and Stream,* vol. xxii., page 203.

In defence of collecting for scientific purposes. Under the same heading is a protest by H. W. C. against indiscriminate egg collecting by boys "as a business," but in favor of collecting for scientific purposes.

1884. Chubb, A. B. Birds and Electric Lights. *Forest and Stream,* vol. xxii., page 26.

List of species picked up at the foot of electric light masts in Cincinnati, Ohio.

1884. (Cooper), C. (V.) Insectivorous Grouse. *Canadian Sportsman and Naturalist,* vol. iii., page 261.

A specimen of the ruffed grouse (*Bonasa umbellus*), found to have its crop full of caterpillars of *Notodonta concinna,* commonly known as the red-humped apple-tree caterpillar.

1884. Editorial. The Sacrifice of Song-Birds. *Forest and Stream,* vol. xxii., August 7, page 21.

For millinery purposes.

1884. Editorial. Domesticating Game-Birds. *Forest and Stream,* vol. xxi., No. 14, page 264.

Notes on the ruffed grouse, the pintail grouse, and the common quail.

1884. Editorial. The Destruction of Small Birds. *Forest and Stream,* vol. xxii., page 24.

Statistics relating to the appalling magnitude of the millinery trade in bird-skins.

1884. G. M. S. The Migratory Quail. *Forest and Stream,* vol. xxii., page 385.

Birds turned loose at Springfield, Massachusetts, two years ago, have raised young, and are still there and are there to stay.

1884. Horsford, B. The Yellow-Bellied Woodpecker. *Forest and Stream,* vol. xx., No. 7, page 124.

Kills trees by girdling them.

1884. "Merlin." Protect the Small Birds. *Forest and Stream,* February 28, page 83.

Against the "mania" for possession of immense series of birds' eggs and skins.

1884. "Nessmuck." Robins and Strawberries. *Forest and Stream,* vol. xxii., September 25, page 164.

Verdict heavily against the robin.

1884. Noe, Fletcher M. Are Owls Beneficial to the Farmer? Also notes on the species in Indiana. *Indiana Farmer,* July 5, 1884.

1884. "Pickett." Fruit-Eating Birds. *Forest and Stream,* vol. xxii., August 28, page 83.

Statistical table showing contents of stomachs of various species.

1884. Prout, J. S. Acclimation of Foreign Birds (in the United States). *Forest and Stream,* vol. xxii., page 364.

In view of the unsuccessful attempts with the European quail, skylark, etc., it is suggested that such birds should be turned out in the South (Florida, Louisiana, Mexico), instead of the North.

1884. R. T. The Robin as a Game Bird. *Forest and Stream,* vol. xxii., September 4, page 105.

1884. Ragsdale, G. H. A Plea for the Hawks. *American Field,* vol. xxi., March 22, page 281.

Urging discrimination in the slaughter of these birds, the greater part of which are beneficial, they subsisting chiefly upon noxious mammals and insects.

1884. [Special.] Small Bird Destruction. *Forest and Stream,* vol. xxii., September 11, page 123.

Forty thousand tern skins taken in Massachusetts sent during the past year to Liverpool for millinery purposes. Comment also on the destruction of woodpeckers and other small birds which fall victims to the gunning craze.

1884. Warren, Harry. Diurnal Rapacious Birds. (With special reference to Chester County, Pennsylvania.) Agriculture of Pennsylvania, 1883 (1884), pages 96-112.

A very important paper on the food of various hawks, with report of numerous examinations of the contents of stomachs.

1884. Weed, Clarence M. Does the Crow Blackbird eat Crayfish? *American Naturalist,* vol. xviii., page 832.

Part of a crayfish was found in the stomach of a young crow blackbird.

1884. Weed, Clarence Moores. The Food of Young Birds. Report Michigan State Board of Agriculture, 1884. Also Report Michigan State Horticultural Society, 1884.

Report on food of nestling catbirds, robins, bluebirds, and crow blackbirds, with discussion of economic relations.

1885. Bennett, Geo. B. The Lesson of a Market. *Forest and Stream,* vol. xxiv., June 4, pages 366, 367.

An account of the small birds exposed for sale in the market at Norfolk, Virginia.

1885. Brown, E. L. An Insectivorous Kite. *The Naturalist,* vol. i., No. 3, page 125.

1885. Dury, Charles. Notes on the Food of Raptorial Birds. Journal of Cincinnati Society of Natural History, vol. viii., pages 62-67. Also reprinted in Random Notes on Natural History, vol. i., No. 8.

Notes on the contents of stomachs of various species of hawks and owls.

1885. Hayward, R. Curious Food of the Kingfisher. *The Auk,* vol. ii., page 311.

Found in stomach, fragments of various beetles belonging to the families Carabidæ, Dytiscidæ, and Scarabæidæ.

1885. Noble, G. Destructive Electric-Light Towers. *Forest and Stream,* vol. xxv., November 12, page 305.

During a rainy night in October one hundred and five birds were picked up under one light tower in Savannah, Ga.

1885. Noe, Fletcher M. The Value of Birds as Insect Destroyers. *Indiana Farmer,* January 17, 1885. (Abstract of paper before State Board of Agriculture.)

1885. Warren, B. H. Blackbird's Food. Facts from the diary of a field-working naturalist, showing the piscivorous habit of two species of the genus Quiscalus. Agriculture of Pennsylvania, Report for 1885, pages 157-159.

Statistics of examinations of stomachs of numerous specimens of *Quiscalus purpureus* and *Quiscalus major.*

1885. Warren, B. H. Birds' Food. Agriculture of Pennsylvania, pages 150-156.

On the food of robin and catbird.

1885. "X." Foreign Game Birds in America. *Forest and Stream,* vol. xxv., September 3, pages 103, 104.

An important historical paper on the subject.

1886. Amory, Charles F. That Thieving Rice-Bird. *Forest and Stream,* vol. xxvii., No. 15, November 4, pages 283, 284.

On its probable utility as well as destructiveness.

1886. Bowles, E. D. English Sparrow as Egg Robber. *Forest and Stream,* vol. xxvi., page 5, January 28, 1886.

1886. Butler, A. W. The Periodical Cicada in Southeastern Indiana. United States Department of Agriculture, Division of Entomology, Bulletin No. 12, pages 24-31.

Refers to birds known to eat cicadas.

1886. Chapman, Frank M. Birds and Bonnets. *Forest and Stream,* vol. xxvi., No. 6, February 25, page 84.

List of birds seen on women's hats in an afternoon's walk in New York City.

1886. Dury, Charles, Fisher, W. H., Warden, R. H., Langdon, F. W., James, J. F. Papers on the Destruction of Native Birds. Journal of the Cincinnati Society Natural History, vol. ix., pages 163-224.

An extended discussion of the subject.

1886. Editorial. A Use for Falconry. *Forest and Stream,* vol. xxvii., No. 13, October 21, page 241.

Trained hawks suggested as a means of protecting rice-fields from the depredations of the rice-birds.

1886. Editorial. Snipe Decoration. *Forest and Stream,* vol. xxvii., No. 15, November 4, page 281.

Use of snipe and migratory game-birds for millinery purposes in lieu of song-birds.

1886. Grant, W. G. The Terns of Matinicus Rock (Coast of Maine). *Forest and Stream,* vol. xxvii., No. 25, January 13, page 485.

On the wholesale slaughter of terns at this point for millinery purposes by C. E. Cahoon, of Taunton, Massachusetts.

1886. Miller, Warner. Ravages of Rice-Birds. *Congressional Record,* 49th Congress. June 11, 1886, page 5747.

A loss of six dollars and eighty-seven cents per acre by the rice-birds to the rice crop and the total annual loss to one plantation is estimated at eight thousand two hundred and fifty dollars.

1886. Noe, Fletcher M. Notes on the Destruction of Indiana Birds for Millinery Purposes. *Indianapolis News,* February 22, 1886.

1886. Thompson, Maurice. Some Song Birds of Indiana. Report of the State Board of Agriculture, 1885, pages 247-252.

1887. Fisher, A. K. Hawks and Owls. *American Field,* vol. xxvii., page 247.

Notes on economic value.

1887. Hay, O. P. The Red-headed Woodpecker a Hoarder. *The Auk,* vol. iv., page 193.

An insect-eating species, and during winter the birds avail themselves of grain, grass-seeds, and the softer nuts. Some eat fruit and berries.

1887. Marshall, William. Birds and their Daily Bread. *Popular Science Monthly,* vol. xxx., page 600.

Food of birds very diversified.

1887. Merriam, C. H. Report of the Ornithologist and Mammalogist. United States Department of Agriculture, Report, 1886, pages 227-258.

Notes on importance of subject, progress of work, and copies of circular letters sent to various classes of agriculturists throughout the country. Extracts from the answers received have served as the basis for an article on the English sparrow, its introduction, rate of increase, rate of spread, relations to other birds, and economic importance as an enemy to the gardener and fruit-grower, effects on agriculture, failure to reduce the numbers of caterpillars, and recommendations for protective legislation. On the rice-bird, its ravages and habits, and on the distribution and migration of birds.

1888. Bailey, Vernon. Report of Some of the Results of a Trip through Part of Minnesota and Dakota. United States Department of Agriculture, Annual Report, 1887, page 426.

Notes on damage done by the yellow-headed blackbird by devouring grain, both in planting and harvesting seasons. Also notes on distribution and habits of red-winged blackbird, purple grackle, Brewer's blackbird, cow-bird, bobolink, and Franklin's gull.

1888. Fisher, A. K. Food of Hawks and Owls. United States Department of Agriculture, Annual Report, 1887, pages 402-422.

Statements of the stomach contents of more than one thousand hawks and owls. The following species are mentioned: Swallow-tailed kite, Mississippi kite, marsh-hawk, sharp-shinned hawk, Cooper's hawk, goshawk, red-tailed hawk, red-shouldered hawk, Swainson's hawk, broad-winged hawk, rough-legged hawk, golden eagle, bald eagle; prairie falcon, duck hawk, pigeon hawk, sparrow hawk, barn owl, long-eared owl, short-eared owl, barred owl, Florida barred owl, sawwhet owl, screech owl, great horned owl, snowy owl, hawk owl, and burrowing owl. Only a few of these species were found to be injurious.

1888. Fisher, A. K. Experiments in Poisoning. United States Department of Agriculture, Annual Report, 1887, pages 423-426.

Details of experiments with strychnine and arsenic in various forms and corrosive sublimate as poisons for birds.

1888. Fisher, A. K. Notes on the Depredations of Blackbirds and Gophers in Northern Iowa and Southern Minnesota. United States Department of Agriculture, Annual Report, 1887, pages 454-456.

Injuries in fall of 1887.

1888. Warren, B. H. Report on the Birds of Pennsylvania, with special reference to food habits. Harrisburg, 1888, pages i.-xii., 1-260.

An elaborate report based on the examination of over three thousand stomachs. Illustrated with fifty plates. A revised and enlarged edition covering four hundred and fifty pages was published in 1890. The notes on food materials are unusually complete.

1889. Baker, F. C. Notes on the Food of Birds. Proceedings Academy of Natural Sciences of Philadelphia, pages 266-270.

Upwards of three hundred stomachs examined in Florida.

1889. Barrows, W. B. The Rose-breasted Grosbeak. United States Department of Agriculture, Report, 1888, pages 535, 536.

Extracts from correspondence tend to prove this species a valuable friend to the farmer from the fact of its feeding freely on the Colorado potato-beetle.

1889. Barrows, W. B. The Food of Crows. United States Department of Agriculture, Report, 1888, pages 498-535.

Short introduction, followed by a long discussion on both the common and fish-crow, with many extracts from correspondence. Information has been collected on distribution of the crows, injury to various cereals, damage to other crops, other vegetable food, distribution of noxious seeds, as a destroyer of eggs and young of poultry and wild birds, insect food, as an enemy to grasshoppers, as an enemy to potato beetles, insect food as revealed by an examination of the stomachs, as an enemy to field mice, miscellaneous animal food, and as a scavenger. The paper is closed by the results in detail of the examination of a large number of stomachs of the common and a few of the fish-crow.

1889. Blatchley, W. S. Our Feathered Friends of Indiana. A series of five articles in *Indiana Farmer,* under dates of May 4, May 18, May 25, and November 23, 1889, and March 29, 1890.

1889. Fisher, A. K. The Sparrow Hawk. United States Department of Agriculture, Report, 1888.

Range and habits, extracts from correspondence and account of the contents of one hundred and sixty-three stomachs from various localities.

1889. Fisher, A. K. The Short-eared Owl. United States Department of Agriculture, Report, 1888, pages 496-498.

Short account of the habits and food of this species, with extracts from correspondence.

1889. Merriam, C. H. Introduced Pheasants. United States Department of Agriculture, Report, 1888, pages 484-488.

Account of the introduction of certain game-birds into the western portion of the United States, and extract from correspondence in regard to them.

1889. Strode, W. S. Food of the Owls. *American Naturalist,* vol. xxiii., pages 17-24.

Treats especially of great horned owl.

1890. Cook, C. B. The English Sparrow. Michigan Agricultural Experiment Station, Bulletin 62, May, 1890.

General notes on English sparrow; description; native birds likely to be mistaken for it, and means of destruction.

1890. Fisher, A. K. A Word for the Hawks and Owls. *The Observer,* Portland, Connecticut, vol. i., No. 6.

Economic value of these birds.

1890. Fisher, A. K. The Marsh Hawk, Screech Owl, and Flammulated Screech Owl. United States Department of Agriculture, Report, 1889, pages 370-376.

Discussion of the distribution and habits of these species, with extracts from various publications.

1891. Barrows, W. B. Seed-Planting by Birds. United States Department of Agriculture, Report, 1890, pages 280-285.

Discussion of the subject in various phases and statement of some of the problems to be solved.

1891. Bolles, Frank. Yellow-bellied Woodpeckers and Their Uninvited Guests. *The Auk,* vol. viii., pages 256-270.

1891. Butler, Amos W. Our Birds and What they do for the Farmer. Report State Board of Agriculture, Indiana, 1890, pages 113-125. Also issued separately in pamphlet form.

1891. Goss, N. S. History of the Birds of Kansas. Topeka, George W. Crane & Co., pages 1-693.

Many references to food habits.

1891. Mackay, George H. Habits of the Golden Plover (*Charadrius dominicus*) in Massachusetts. *The Auk*, vol. viii., pages 17-24.

With paragraph on feeding habits, pages 18, 19.

1891. Mackay, George H. Habits of the Scoters. *The Auk*, vol. viii., pages 256-270.

1891. Merriam, C. Hart. Birds which Feed on Mulberries. United States Department of Agriculture, Report, 1890, page 285.

List of twenty-six species of birds which had been observed feeding upon mulberries by Dr. A. K. Fisher and the author.

1891. Russ, Carl. Take Care of the Birds. *Popular Science Monthly*, vol. xxxix., page 687.

A plea for bird protection.

1892. Bendire, Charles. Life Histories of North American Birds. Washington, United States National Museum, Special Bulletin, No. 1, pages i.-viii., 1-446, plates I.-XII.

Elaborate accounts, with special reference to breeding habits and eggs of the gallinaceous birds and the birds of prey. Eggs illustrated in twelve plates. Many references to feeding habits.

1892. Bolles, Frank. Young Sapsuckers in Captivity. *The Auk*, vol. ix., pages 109-119.

1892. Langille, J. Hibbert. Our Birds in their Haunts. New York: Orange Judd Co., pages 1-630.

A popular, illustrated treatise on the birds of Eastern North America. Copyrighted in 1884.

1892. Mackay, George H. Habits of the American Herring Gull in New England. *The Auk,* vol. ix., pages 221-228.

Contains a few remarks on feeding habits.

1892. Miller, H. H. Food Habits of Hawks and Owls in Maryland. *Shooting and Fishing,* vol. xii., No. 19, page 366.

1892. Wilcox, E. V. The Food of the Robin. Ohio Agricultural Experiment Station, Bulletin 43, September, 1892, pages 115-131.

Details of a somewhat extended study of the food of the robin as indicated by a study of stomach contents. A total of one hundred and eighty-seven stomachs were examined of birds killed during the spring and summer months. In the summary it is estimated that the beneficial species of fruit and insects eaten will amount to 52.4 per cent. of the total, the injurious to 18.6 per cent., while the remainder consists of species of which the economic importance is as yet unknown.

1893. Barrows, W. B. The Food of the Horned Larks or Shore Larks (*Otocoris*). United States Department of Agriculture, Report, 1892, pages 193-197.

Account of the examination of the stomachs of fifty-nine horned larks, and summary of results.

1893. Beal, F. E. L. Food Habits of the Cedar-Bird. United States Department of Agriculture, Report, 1892, pages 197-200.

Account of the examination of one hundred and twenty-five stomachs of the common cedar waxwing, with a short summary of the result.

1893. Brewster, William. A Brood of Young Flickers and How they were Fed. *The Auk,* vol. x., pages 231-236.

1893. Butler, A. W. Further Notes on the Evening Grosbeak. *The Auk,* vol. x., pages 155-157.

General notes with references to feeding.

1893. Editorial. Feathered Women. *The Times,* London, England, October 17, 1893.

Leading article protesting against use of birds for millinery purposes.

1893. Fisher, A. K. The Hawks and Owls of the United States in their Relation to Agriculture. United States Department of Agriculture, Division of Ornithology and Mammalogy, Bulletin No. 3, 1893, pages 1-210, plates 1-26.

A remarkable volume of more than two hundred pages, with full discussion of feeding habits of each species, and a colored plate illustrating its appearance.

1893. Hine, Jane L. Birds that Befriend Our Forest Trees. A series of chapters irregularly published in the *Farmers' Guide,* Huntington, Indiana. Chapter i. in vol. v., No. 1, January 1; chapter ii. in vol. v., No. 2, January 15; chapter iii. in vol. v., No. 3, February 1; chapter iv. in vol. v., No. 4, February 15; chapter v. in vol. v., No. 6, March 15; chapter vi. in vol. v., No. 27, December 15.

1893. Lucas, F. A. Food of Humming-birds. *The Auk,* vol. x., pages 311-315.

1893. McLouth, C. D. Protection of Birds from the Boys. *Science,* vol. xxii., pages 347-348.

Recommends for schools (1) Punishment of guilty by law; (2) Teaching of sentiment; (3) Close study of birds; (4) Organizing societies for bird protection.

1893. Shufeldt, R. W. Some Recent Economic and Scientfic Questions in Ornithology. *Science,* vol. xxii., pages 255-256, November 16, 1893.

Discusses causes for recent decrease in birds around large cities and remedial measures and legislation.

1893. Weed, Clarence Moores. The Relations of Birds to Carnivorous Insects. Proceedings Society Promotion Agricultural Science, Fourteenth Meeting, pages 70-74.

A general discussion showing incorrectness of calling all parasites and predaceous insects beneficial.

1894. Barrows, W. B. Food Habits of the Kingbird or Bee Martin. United States Department of Agriculture, Report 1893, pages 233-234.

Brief discussion of range, habits, and food as indicated by a study of the stomach contents.

1894. Card, F. W. Birds Injuring Apples. *Garden and Forest,* vol. vii., page 114.

Brief mention of birds attacking the fruit.

1894. Hine, Jane L. Farmers, Take Care of your Birds. The *Farmers' Guide,* Huntington, Indiana, vol. vi., No. 10, May 15, 1894.

1894. Smyth, E. A., Jr. Are all Birds of Prey Injurious to the Farmer? Virginia Agricultural Experiment Station, Bulletin 38, pages 23-39.

Notes on the feeding habits of the common hawks and owls of Virginia, largely compiled from "The Hawks and Owls of the United States."

1894. Troop, James. Protecting Fruit from Birds. Purdue University Agricultural Experiment Station, Bulletin 53, pages 125-126.

Details of an experiment in the use of netting to protect cherries from the attacks of birds, in which it was shown that the saving from its use would pay for the original cost the first year, under conditions in which the fruit is obliged to remain upon the tree until ripe.

1894. Winship, A. E. Bird Day. *Journal of Education,* May 24, 1894.

Account of observance of bird day in schools of Oil City, Pennsylvania.

1895. The American Crow. The Wilson Ornithological Chapter of the Agassiz Association, Bulletin No. 5, March, 1895, pages 5-42.

Notably feeding, nesting, roosting, flight, relative abundance.

1895. Barrows, W. B., and Schwarz, E. A. The Common Crow in the United States. United States Department of Agriculture, Division of Ornithology and Mammalogy, Bulletin No. 6, 1895, pages 1-98.

General habits of the crow, geographic distribution, migration, crow-roosts; animal food of the crow; methods of investigation, method of examining stomachs; relative percentages of animal and vegetable food; relation of the crow to mammals; relation of the crow to other birds; relation of the crow to reptiles, fishes, and invertebrates; insect food of the crow; testimony of correspondents on insects eaten by the crow; vegetable food of the crow,—corn, wheat, oats, barley, buckwheat, mast, grass and weed seeds, wild rice, fruit; protection of crops,—tarring corn, use of poison, bounties; list of localities at which crows' stomachs were collected.

1895. Beal, F. E. L. Crow Blackbirds and their Food. United States Department of Agriculture, Yearbook, 1894, pages 233-248.

Discussion of the purple grackle and its two subspecies, the bronzed and Florida grackles. The following subjects are treated: Geographic range, observations regarding the diet of the crow blackbird, examinations of stomach contents, various articles of bird diet, grains and fruits as blackbird food, seeds as bird food, food of the young, and summary.

1895. Beal, F. E. L. Preliminary Report of the Food of Woodpeckers. United States Department of Agriculture, Division of Ornithology and Mammalogy, Bulletin No. 7, pages 1-33. Review in *American Naturalist,* vol. xxx., page 496; *Popular Science Monthly,* vol. xlix., page 573.

General remarks and table showing food percentages, followed by short discussions of the range, habits, and food of the following species: downy, hairy, red-headed, red-bellied, and pileated woodpeckers, flicker, and yellow-bellied sapsucker.

1895. Bendire, Charles. The Cowbirds. Report United States National Museum, 1893, pages 587-624, plates 1-3.

Extended account of the life history of various species of cowbirds, with especial reference to their relations to other birds.

1895. Bendire, Charles. Life Histories of North American Birds, from the Parrots to the Grackles. Washington, Smithsonian Contributions to Knowledge, 985, 1895, pages i.-x., 1-518, plates I.-VII.

A continuation of the work listed above (1892), with many references to feeding habits.

1895. Blatchley, W. S. Protect the Woodpeckers. Indianapolis *Sunday Journal,* October 27, 1895.

1895. Fisher, A. K. Hawks and Owls as Related to the Farmer. United States Department of Agriculture, Yearbook, 1894, pages 215-232.

Discussion of the economic importance of the birds of prey, taking up the subjects of cause of the prejudice against birds of prey, some characteristics of rapacious birds, food habits of the principal birds of prey, harmless species of hawks and owls, wholly beneficial hawks, hawks and owls mostly beneficial, and harmful hawks and owls. All the common North American species are discussed.

1895. Forbush, E. H. Birds as Protectors of Orchards. Massachusetts Crop Report, Bulletin No. 3, Series of 1895, pages 20-32. Also in Report Ontario Entomological Society, 1895, pages 53-62.

Notes on feeding habits of the chickadee, nuthatch, brown-creeper, downy woodpecker, and others. Especial attention is given to the chickadee.

1895. Hall, F. H. Birds, Fruits, and Flowers. *National Stockman and Farmer,* 1895, page 559.

Discussion of value of birds to fruit-growers. Experience with Russian mulberry in attracting birds.

1895. Hudson, W. H. (Bird Protection and the Clergy.) English Society for Protection of Birds, Letter to Clergy, November, 1895. Reprint by Wisconsin Audubon Society, 1898.

Discussion of use of birds for millinery purposes.

1895. Lucas, F. A. The Tongues of Woodpeckers. United States Department of Agriculture, Division of Ornithology and Mammalogy, Bulletin No. 7, pages 33-39, three plates.

Discussion of the anatomy of the tongues of the various species of woodpeckers, the variation in form and relation of the tongue to the food.

1895. Weed, Clarence M. The Robin. *The Mirror and Farmer* (Manchester, New Hampshire), October 4 and 11, 1895.

A discussion of economic status of the robin.

1895. Winship, A. E. Bird Day. *The Outlook,* April 6, 1895, page 560.

Account of original bird day at Oil City, Pennsylvania, on the first Friday in May, 1894. Plea for general adoption.

1896. Babcock, C. A. Bird Day. *Journal of Education,* April 4, 1896.

1896. Beal, F. E. L. The Meadow Lark and Baltimore Oriole. United States Department of Agriculture, Yearbook, 1895, pages 419-430.

Brief notes on distribution and habits of the two birds, followed by statements of their food as indicated by the examinations of a large number of stomachs. Almost three-fourths of the food of the meadow lark was found to consist of insects, and of these a very large percentage were grasshoppers and crickets. The accusation of pulling sprouting grain and feeding upon grain generally appears not without basis, but the damage done in this manner is more than counterbalanced by the numbers of insects eaten. The food of the oriole was found to consist almost exclusively of insects, and these to a large extent of noxious species. No question can be raised as to the value of this bird as an insect destroyer.

1896. Butler, A. W. A Century of Changes in the Aspects of Nature. President's Address. Proceedings of the Indiana Academy of Science, 1895, pages 31-42.

Refers to changes in avifauna of Indiana.

1896. Chansler, E. J. Our Feathered Beauties. *Indiana Farmer,* February 15, 1896, page 6.

1896. Fisher, A. K. Food of the Barn Owl. *Science,* New Series, vol. iii., pages 623-624. Reprint in *Forest and Stream,* vol. xlvi., page 492.

Results of studies of food.

1896. Forbush, E. H. The Crow in Massachusetts. Massachusetts Board of Agriculture, Crop Report Bulletin, 1896, No. 4, pages 24-40.

General notes on the American crow: migration, gregarious habits, mating and nesting habits, digestive capacity, food, the protection of crops, summary.

1896. Hine, Jane L. Cedar Waxwing. *The Farmer's Guide,* vol. viii., No. 12, June 15, 1896.

1896. Hine, Jane L. Farm Birds in Northern Indiana. *The Farmer's Guide,* Huntington, Ind., vol. viii. A series of articles in chapters in the following numbers of that paper: No. 3, February 1, 1896; No. 4, February 15; No. 5, March 1; No. 6, March 15; No. 7, April 1; No. 8, April 15; No. 9, May 1.

1896. Kirkland, A. H. The Army-Worm. Massachusetts Crop Report, July, 1896, page 35.

List of ten birds feeding on army-worms: Kingbird, phœbe, bobolink, cowbird, red-winged blackbird, Baltimore oriole, crow blackbird, English sparrow, chipping sparrow, robin. Probably also meadow-larks, crows, flickers, quail.

1896. Merriam, Florence A. How Birds affect the Farm and Garden. *Forest and Stream,* vol. xlvii., pages 103, 123, 144.

An important summary, based on the investigations of the Division of Biological Survey.

1896. Oberholser, H. C. A preliminary list of the birds of Wayne County, Ohio. Ohio Agricultural Experiment Station, Bulletin No. 4, Technical Series, pages 243-354.

Notes on one hundred and eighty-three species of birds known to inhabit this region, together with a list of the species thought to be occasional visitors. Notes on food of a few species.

1896. Palmer, T. S. Bird Day in the Schools. United States Department of Agriculture, Division of Biological Survey, Circular No. 17.

History of the movement; discussion of object and value.

1896. Richards, Harriet. The Birds at Dinner. *Popular Science Monthly,* vol. xlix., pages 337-342.

Nearly all birds feed their young on insects, worms, or some form of animal food, and also depend mainly on that food for themselves during nesting season, although at other seasons their favorite food may be grains and berries.

1896. Warren, B. H. Our Home Birds. Pennsylvania Agricultural Experiment Station Report, 1895, pages 244-265.

Popular account of the birds of Pennsylvania and discussion of the value of birds as destroyers of vermin and the danger of destroying them.

1897. Anthony, A. W. The Roadrunner as a Destroyer of Caterpillars. *The Auk,* vol. xiv., page 217.

Roadrunners in California feed on caterpillars of *Agraulis vanillæ,* which attack leaves of passion vines.

1897. Bailey, William L. Disgorgement of Cherry Stones again Noted. *The Auk,* vol. xiv., pages 412, 413.

Cherry stones disgorged by young robins, catbirds, and wood robins (thrush?).

1897. Beal, F. E. L. Recent Investigations of the Food of European Birds. *The Auk,* vol. xiv., pages 8-14.

Review of papers by Hollrung and Gilmour; remarks on methods of estimating percentages of food.

1897. Beal, F. E. L. The Blue Jay and its Food. United States Department of Agriculture, Yearbook, 1896, pages 197-206.

General remarks on habits and distribution of blue jay, followed by an account of examination of two hundred and ninety-two stomachs. The bulk of the food was found to be of vegetable origin, namely mast, the amount of fruit and cereals being small. In certain seasons of the year many insects were eaten, few of them beneficial. But a very small percentage of the whole consisted of vertebrate remains, thus giving little support to the reports of damage done by eating small birds, nor were birds' eggs eaten to any extent. The relative proportions of the various foods varied remarkably from season to season.

1897. Beal, F. E. L. Some Common Birds in their Relation to Agriculture. United States Department of Agriculture, Farmer's Bulletin, No. 54.

A short popular discussion of the food habits of a number of birds of more or less importance to the farmer. Treats of the black and the yellow-billed cuckoos; the downy, golden-winged, hairy, red-shafted, and red-headed woodpeckers; the yellow-bellied woodpecker or sapsucker; the kingbird; the phœbe; the blue jay; the bobolink or rice-bird; the red-winged blackbird; the meadow-lark or old field-lark; the Baltimore oriole; the crow blackbird; the song, chipping, field, and tree sparrows; the snowbird; the rose-breasted grosbeak, the barn, cliff, and white-bellied swallows, and the martin; the cedar-bird; the cat-bird; the brown thrasher; the house-wren; the robin; and the bluebird. Most of these species are shown to be highly beneficial in their feeding habits.

1897. Bruner, L. The Birds of Nebraska. Nebraska State Horticultural Society Report, 1896, pages 98-178, fifty-one figures.

Notes on the distribution, food habits, etc., of birds of Nebraska, with list of forms found within the State. Corrected to April, 1896.

1897. Dutcher, William. Report of A. O. U. Committee on Protection of North American Birds. *The Auk,* vol. xiv., pages 21-32.

Report of progress during the year.

1897. Grinnell, Joseph. Disgorgement among Song Birds. *The Auk,* vol. xiv., page 318.

Robins and cedar-birds disgorge seeds of pepper-tree.

1897. Jones, Lynds. The Oberlin Grackle Roost. The Wilson Bulletin, vol. ix., O. S. Bulletin No. 15, July 30, 1897, pages 39-56.

Habits during courtship and nesting; how the young are taken to the roost; eat fruit, then ripening corn; time of roosting; in the North the breeding season is beneficial to agriculture; the roosting season the reverse.

1897. Judd, Sylvester D. Methods in Economic Ornithology, with Special Reference to the Catbird. *American Naturalist,* vol. xxxi., pages 392-397.

Proportions of foods ascertained by examination of stomach contents; preferences by field observations; shy birds caged and various foods offered.

1897. Kenyon, F. C. The English Sparrow not always a Nuisance. *American Naturalist,* vol. xxxi., page 73.

Dr. Judd reports fondness for dandelion seeds; saw the sparrow catch and devour a cicada. His ability to catch insects on wing discussed.

1897. Kirkland, A. H. The Sugar Maple Borer. Massachusetts Crop Report, June, 1897, page 32.

Presumptive evidence that hairy woodpecker, downy woodpecker, and flicker feed on larvæ of *Plagionotus speciosus.*

1897. Lucas, F. A. The Tongues of Birds. United States National Museum, Report for 1895, pages 1001-1019.

Discusses the relation of the tongue to the hyoid, and the different forms of development of the two in the various groups of birds.

1897. Owen, Daniel E. Notes on a Captive Hermit Thrush. *The Auk,* vol. xiv., pages 1-8.

Account of feeding habits of hermit thrush; method of determining rate of digestion.

1897. Palmer, T. S. Extermination of Noxious Animals by Bounties. United States Department of Agriculture, Yearbook, 1896, pages 55-68.

History of bounty system in the United States and other countries. Bounties on birds almost invariably pernicious.

1897. Proctor, Thomas. Disgorgement among Song Birds. *The Auk,* vol. xiv., page 412.

Wood thrushes and other true thrushes disgorge cherry pits; disgorgement also noticed in red-eyed vireo, myrtle bird, and European robin.

1897. Reed, J. Harris. Notes on the American Barn Owl in Eastern Pennsylvania. *The Auk,* vol. xiv., pages 374-383.

Occurrence, nesting habits, feeding habits.

1897. Silloway, P. M. Sketches of some Common Birds. Cincinnati. The Editor Publishing Company. Pages 1-331.

Many references to food habits.

1897. Warren, B. H. The Army-Worm. Report Pennsylvania State College, 1896, pages 164-220.

Record of studies of food of many birds during an army-worm outbreak, showing that nearly all fed freely on the pests.

1898. Adams, Stephen J. Swallow Investigations. The Wilson Bulletin, vol. x., O. S. No. 20, May 30, 1898, pages 42-43.

They take enormous numbers of insects; nearly, if not quite, all taken on the wing. Barn swallows take enormous numbers of apple-maggot flies.

1898. Bailey, L. H. The Birds and I. Cornell University, Teachers' Leaflet, No. 10.

Popular discussion of relations of birds to children. Pictures of many bird-houses.

1898. Beal, F. E. L. Birds that Injure Grain. United States Department of Agriculture, Yearbook, 1897, pages 345-354.

After a short discussion of the damage done by birds to the wheat crop and the cause of increased numbers of blackbirds, the more important noxious species are taken up in detail. The following are treated: Crow, crow blackbird, red-winged blackbird, yellow-headed blackbird, rusty grackle, cowbird, mourning dove, California valley quail, horned lark, and certain imported pheasants.

1898. Beal, F. E. L. The Food of Cuckoos. United States Division of Biological Survey, Bulletin 9, pages 1-15.

General notes on North American cuckoos, followed by an account of the examination of one hundred and fifty-five stomachs of both species. Food was found to consist almost exclusively of animal matter. Nearly fifty per cent. of the whole was composed of caterpillars, of which, contrary to the usual habits of birds, hairy species were in the majority. The percentage of Orthoptera ranged from three per cent. in May to forty-three in July, mostly arboreal forms, and there were from five to six and one-half per cent. of miscellaneous insects, beetles and bugs respectively. No particular support was found to the accusation that they are in the habit of sucking eggs of other birds.

1898. Blanchan, Neltje. Birds that Hunt and are Hunted. New York: Doubleday & McClure Company. Pages i.-xii., 1-359.

Life histories of one hundred and seventy birds of prey, game birds, and water fowls, with colored plates of many of them. Much economic information.

1898. Butler, Amos W. The Birds of Indiana. Twenty-second Annual Report State Geologist of Indiana, pages 515-1187.

A descriptive catalogue of the birds that have been observed within the State, with an account of their habits. Much information as to food.

1898. Birds and Trees. Audubon Society of the State of Connecticut.

A four-page pamphlet containing selections suitable for bird day.

1898. Brewster, William. The Short-eared Owls of Muskeget Island. *The Auk,* vol. xv., pages 211-213.

"Bird protectors would do well to study more closely the balance of nature." Notes on owls of Muskeget Island.

1898. Cram, William Everett. Woodpeckers and their Ways. *Popular Science Monthly,* vol. liii., pages 339-397.

Eating aphides in fall.

1898. Dutcher, William (Chairman). Report of the A. O. U. Committee on Protection of North American Birds. *The Auk,* vol. xv., pages 81-114.

An extended discussion showing work in the different States, with general recommendations.

1898. Hornaday, W. T. The Destruction of Our Birds and Mammals. Second Annual Report of the New York Zoölogical Society, pages 77-126.

A circular letter of inquiry was sent to persons in various States and Territories, and the results are here given. The subjects for investigation were the per cent. of decrease of birds in various localities, and the causes for such decrease. The results are given in detail.

1898. Helps to Bird Study. Massachusetts Audubon Society, 1898.

A pamphlet of thirty-two pages giving selections in prose and verse helpful for bird-day programmes.

1898. JUDD, SYLVESTER D. The Food of Shrikes. United States Division of Biological Survey, Bulletin 9, pages 15-26.

General notes on North American shrikes, followed by an account of the examination of one hundred and fifty-five stomachs of both species. So far as could be determined from the stomachs of sixty-seven butcher-birds the food closely resembled that of the sparrow-hawk. About twenty-six per cent. of the food consisted of mice, thirty-four per cent. of small birds, including many English sparrows, consisting almost wholly of seed-eating species, and the remainder of insects, mostly grasshoppers. The food of the loggerhead differs in the much smaller percentage of mice and birds, about twenty-four per cent. The insects eaten consist largely of Orthoptera, and in the spring of beetles, many of them predaceous species. Both the butcher-bird and loggerhead eat, to some extent, caterpillars.

1898. KELLICOTT, D. S. Feeding Habits of Winter Birds of Interior Ohio. Journal Columbus Horticultural Society, vol. xiii., pages 45-51.

A brief discussion of feeding habits with list of winter residents.

1898. LAZENBY, WILLIAM R. Preserve the Birds. Journal Columbus Horticultural Society, vol. xiii., pages 44, 45.

A brief discussion of benefits of birds and methods of protecting them.

1898. MERRIAM, FLORENCE A. Birds of Village and Field. A bird book for beginners. Boston: Houghton, Mifflin & Company.

A book of four hundred and six pages with two hundred and twenty illustrations, giving considerable attention to the economic relations of the birds discussed.

1898. NASH, CHARLES W. The Birds of Ontario in Relation to Agriculture. Toronto: Department of Agriculture, 1898, pages 1-64.

A general discussion of the economic status of the common birds of Ontario, with figures of many species.

1898. Sanderson, E. Dwight. The Economic Value of the White-bellied Nuthatch and Black-capped Chickadee. *The Auk,* vol. xv., pages 144-155.

Record of food of twenty-three nuthatches in winter and eleven in early spring, and of nineteen chickadees in winter and nine in spring.

1898. Weed, Clarence Moores. The Causes of the Decrease of Birds. *Granite Monthly,* vol. xxv., pages 211-215.

An illustrated discussion of the subject.

1898. Weed, Clarence Moores. Our Largest Standing Army, the Birds. *Granite Monthly,* vol. xxv., pages 325-331.

Discussion of regulative action of birds.

1898. Weed, Clarence Moores. The Insects Eaten by Birds. *Agricultural Education,* vol. i., pages 4-7, 51-53.

Illustrated discussion of the insects most commonly fed upon by birds.

1898. Weed, Clarence Moores. The Feeding Habits of the Chipping Sparrow. New Hampshire College Agricultural Experiment Station, Bulletin 55, July, 1898.

An illustrated account of a day's work by a pair of chipping sparrows feeding three young. Nearly two hundred visits to the nest were made.

1898. Williamson, E. B. The Economic Importance of some Common Birds. Journal of Columbus Horticultural Society, vol. xiii., pages 33-44.

Touches upon the economic importance of many species of North American birds, with notes on feeding habits of some of them in Ohio.

1899. Beal, F. E. L. Economic Relations of Birds and their Food. Proceedings Twenty-fourth Annual Meeting New Jersey State Horticultural Society, 1899.

A general discussion of the subject.

1899. Chapman, Frank M. Bird Life. New York: D. Appleton & Co.

This admirable book contains a brief account in Chapter I. of the relation of birds to man.

1899. Chapman, Frank M. The Passing of the Tern. *Bird Lore,* vol. i., pages 205-206.

Use of terns for millinery purposes leading to their extermination.

1899. Chase, Victor P. A Blood-thirsty Blue Jay. The Wilson Bulletin, vol. xi., O. S. No. 27, July 30, 1899, pages 55-56.

Eats cherries; killed a newly-fledged English sparrow.

1899. Grant, Annie M. Birds. Report Rhode Island Board of Agriculture, 1899.

Discussion of economic value of birds.

1899. Hodge, C. F., and Ball, Helen A. Our Common Birds. Suggestions for the Study of their Life and Work. Worcester, November, 1899.

Record of work in bird study in schools of Worcester, Massachusetts.

1899. Judd, Sylvester D. Birds as Weed Destroyers. United States Department of Agriculture, Yearbook, 1898, pages 221-232.

A general discussion of the kinds of seeds eaten by birds and the species that eat them.

1899. Lange, D. Our Native Birds; How to Protect them and Attract them to Our Homes. New York: The Macmillan Co.

A small volume of one hundred and sixty-two pages with ten illustrations.

1899. Miller, Olive Thorne. The First Book of Birds. Boston: Houghton, Mifflin & Co. Pages i.-x., 1-150.

In this excellent book for children there is considerable discussion of economic relations, one division of the book being devoted to the relations of birds to man.

1899. Palmer, T. S. The Danger of Introducing Noxious Animals and Birds. United States Department of Agriculture, Yearbook, pages 87-110.

Introduction, means of dispersal, domesticated species may become noxious, sources of danger from noxious species, rats and mice, rabbits, the mongoose, ferrets, stoats, weasels, flying foxes or fruit bats, the English sparrow, the starling, the mina, the kohlmeise or great titmouse, the skylark, the green linnet, and the black thrush; need of legislation; summary.

1899. Osgood, Fletcher. The So-called Sparrow War in Boston. *Bird Lore,* vol. i., pages 137, 138.

Account of the campaign against English sparrows in Boston in the spring of 1898.

1899. O. J. L. Martins Kill the Caterpillars. The Wilson Bulletin, vol. xi., O. S. No. 27, July 30, 1899, pages 60-61.

Built a martin house in orchard; this was soon filled; kept caterpillars and moths from orchard.

1899. Soule, Caroline G. Birds and Caterpillars. *Bird Lore,* vol. i., page 166.

Notes on birds attacking forest tent-caterpillars (*Clisiocampa disstria*) in Vermont.

1899. Weed, Clarence Moores. Our Winter Birds in their Food Relations. *Granite Monthly*, vol. xxvi., pages 77-82.

Food of pine grosbeak, purple finch, junco, chickadee, nuthatches, brown creeper, hairy and downy woodpeckers, and ruffed grouse.

1900. Bailey, Vernon. Where the Grebe Skins Come From. *Bird Lore,* vol. ii., page 34.

Destruction of grebes in California and Oregon to supply demands of fashion.

1900. Beal, F. E. L. Food of the Bobolink, Blackbirds, and Grackles. United States Division of Biological Survey, Bulletin No. 13.

An elaborate report containing a full account of the food relations of the birds indicated.

1900. Burns, Frank L. A Monograph of the Flicker. The Wilson Bulletin, vol. xii., O. S. No. 31, April, 1900, pages 3-82.

An eighty-two page monograph bringing together what is known of the flicker. It would be hard to find birds with fewer harmful qualities than downy and hairy woodpeckers and flicker. They eat ants, coleoptera, and other insects.

1900. Chapman, Frank M. Bird Studies with a Camera. New York: D. Appleton & Co.

This well-known book contains much information regarding economic relations of birds.

1900. Chapman, Frank M. Bird Slaughter in Delaware. *Bird Lore,* vol. ii., page 60.

Note on order for twenty thousand bird-skins placed in Milford, Delaware.

1900. Chapman, Frank M. A Note on the Economic Value of Gulls. *Bird Lore,* vol. ii., pages 10-11.

Value of gulls in feeding on garbage in New York harbor.

1900. Cherrie, George K. The Egret Hunters of Venezuela. *Bird Lore,* vol. ii., pages 50-51.

Account of collection of plumes by natives of Venezuela.

1900. Dibble, Edward B. Two Notes by a Young Observer. *Bird Lore,* vol. ii., page 117.

Observations on robbing of birds' nests by blue jays, and on feeding of young by horned larks.

1900. Dutcher, William. The Bird Protection Fund. *Bird Lore,* vol. ii., pages 60, 90.

Fund of four hundred and seventy-seven dollars raised for protection of gulls and terns. Arrangements being made for wardens to enforce laws.

1900. (Editor.) Sparrows Eat Grapes. *Gardening,* vol. ix., page 29.

Injury to grapes by English sparrows.

1900. Fisher, A. K. A Word for the Hawks and Owls. *American Field,* vol. liv., page 331.

Value as destroyers of vermin.

1900. Hutchins, John. The House Wren as a Depredator. *Bird Lore,* vol. ii., pages 89, 90.

Wrens pierce eggs of chipping sparrows and throw them out of nest, also persecute other birds.

1900. Lemmons, Isabel McC. Notes on the Food of the Chickadee and the Screech Owl. *Bird Lore,* vol. ii., page 59.

Chickadees observed taking "tiny black insects" (probably aphid eggs) from willow. Screech owl's stomachs full of harvest flies "in the pupa form in which they leave the earth."

1900. Palmer, T. S. Protest against the Collection of Plume Birds through Postmasters. *Bird Lore,* vol. ii., page 66.

Account of action of postmaster-general in warning postmasters against illegal killing of birds.

1900. Palmer, T. S. Legislation for the Protection of Birds other than Game-Birds. United States Department of Agriculture, Division of Biological Survey, Bulletin No. 12, pages 1-94.

A general introduction, followed by a summary of the State laws.

1900. Palmer, T. S. A Review of Economic Ornithology. United States Department of Agriculture, Yearbook, 1899, pages 259-292.

A very important article. See Chapter II. of this book.

1900. Palmer, T. S., and Olds, H. W. Laws Regulating the Transportation and Sale of Game. United States Department of Agriculture, Division of Biological Survey, Bulletin No. 14, pages 1-89.

A general summary of existing laws.

1900. Palmer, T. S., and Olds, H. W. Information concerning Game: Seasons, Shipment, and Sale. United States Department of Agriculture, Division of Biological Survey, Circular No. 31.

A brief summary.

1900. Praeger, William F. Birds in Horticulture. Transactions Illinois State Horticultural Society, 1899. Review in *Bird Lore,* vol. ii., page 61.

A paper discussing the economic values of birds.

1900. Roosevelt, Theodore. A Letter from Governor Roosevelt. *Bird Lore,* vol. ii., page 98.

Endorsement of work of Audubon Society.

1901. Babcock, Charles A. Bird Day: How to Prepare for it. Boston: Silver, Burdett & Co. 95 pages.

Ten chapters by the originator of Bird Day in the Schools, designed to "assist school children in the accurate study of a few birds."

1901. Cram, W. E. Food of the Downy Woodpecker. *Bird Lore,* vol. ii., page 142.

Feeding on larvæ in mullein seed-cases.

1901. Dearborn, Ned, and Weed, Clarence M. The Vegetable Food of Birds. *Granite Monthly,* vol. xxx., pages 277-286.

1901. Dearborn, Ned, and Weed, Clarence M. Birds in their Economic Relations. *Granite Monthly,* vol. xxxi., pages 158-167, 276-285.

Discussion of various phases of the subject.

1901. Eckstorm, Fannie Hardy. The Bird Book. Boston: D. C. Heath & Co.

In this unique book there is much information as to economic values.

1901. Eckstorm, Fannie Hardy. The Woodpeckers. Boston: Houghton, Mifflin & Co., pages 1-131.

An admirable guide to the study of this interesting family. Many illustrations, some of them in color.

1901. Eckstorm, Fannie Hardy. Visible Results. *Bird Lore,* vol. iii., page 184.

Reappearance of terns along the Maine coast.

1901. (Editor.) The Sparrow Again. *American Gardening,* vol. xxii., pages 759, 760.

Usefulness of English sparrows in cities.

1901. Grinnell, George Bird. American Duck Shooting. New York: *Forest and Stream* Publishing Company, pages 1-623.

An extended treatment of each species of duck, and a special discussion of the art of duck shooting and of the decrease of wild fowl.

1901. Herrick, Francis Hobart. The Home Life of Wild Birds: A New Method of the Study and Photography of Birds. New York: G. P. Putnam's Sons, 1901.

A beautiful book of one hundred and forty-eight large pages giving methods of photographing birds at close range, and results of study of nesting habits. Notes on food of nestlings of several species.

1901. Hopkins, A. D. Insect Enemies of the Spruce in the Northeast. United States Department of Agriculture, Division of Entomology, Bulletin No. 28, new series, pages 25-26.

Discussion of bird enemies of spruce-destroying beetle.

1901. Judd, Sylvester D. The Relation of Sparrows to Agriculture. United States Division of Biological Survey. Bulletin No. 15, pages 1-98.

An elaborate report on the economic relations of the North American sparrows. Many illustrations.

1901. Miller, Olive Thorne. The Second Book of Birds: Bird Families. Boston: Houghton, Mifflin & Co. Pages i.-x., 1-210.

An illustrated account of the families of North American birds, with numerous references to feeding habits.

1901. Newkirk, Garrett. For Our Encouragement. *Bird Lore,* vol. iii., pages 183, 184.

Increase of birds in Missouri because of bird protection.

1901. Palmer, T. S. Some Fundamental Principles of Bird Protection. *Bird Lore,* vol. iii., pages 79-81.

An admirable discussion of principles on which laws are based.

1901. Palmer, T. S. The Protection of Game a National Question. *Leslie's Weekly,* vol. xciii., pages 254-258, September 21, 1901.

A general discussion.

1901. Palmer, T. S., and Olds, H. W. Digest of Game Laws for 1901. United States Department of Agriculture, Division Biological Survey, Bulletin No. 16, pages 1-152.

A general discussion of the subject.

1901. Peabody, P. B. Saw-Whet Homes. *Bird Lore,* vol. iii., pages 55-58.

Account of nests of saw-whet owls in flicker holes. Evidences of mice and small birds as food.

1901. Smith, Robert Windsor. Food and Gravel. The Wilson Bulletin No. 34, vol. xiii., O. S. March 30, 1901, pages 16, 17.

Song sparrow has much gravel in stomach; robin more dirt than gravel; seed-eating birds require gravel for grinding.

1902. Annin, J., Jr. Winged Enemies of the Brook Trout. *In* The Speckled Brook Trout, edited and illustrated by Louis Rhead. New York: R. H. Russell, pages 127-140.

The following birds are discussed: Night heron, green heron, bittern, kingfisher, ducks, loons, grebes, fish-hawk, bald eagle, bared owl, screech owl.

1902. Blanchan, Neltje. How to Attract the Birds, and Other Talks about Bird Neighbors. New York: Doubleday, Page & Co. Pages 1-224.

Nine chapters on popular ornithology, the first bearing the title: "How to Invite Bird Neighbors." Many illustrations from photographs.

1902. Fisher, A. K. Two Vanishing Birds: The Woodcock and the Wood Duck. Yearbook, United States Department of Agriculture, 1901, pages 447-458.

An excellent illustrated discussion showing the necessity for more adequate protection of these species.

1902. Judd, Sylvester D. Birds of a Maryland Farm: A Local Study of Economic Ornithology. United States Department of Agriculture, Division of Biological Survey, Bulletin No. 17, pages 1-116.

An admirable study of the economic relations of birds on a small area, fully illustrated.

1902. Palmer, T. S. Bird Protection. *In* Mrs. F. M. Bailey's Handbook of the Birds of the Western United States, pages xxxix.-xliii.

A general discussion of the subject.

1902. Palmer, T. S. Directory of State Officials and Organizations concerned with the Protection of Birds and Game, 1902. United States Department of Agriculture, Division of Biological Survey, Circular No. 35.

Lists of State Officials, National Organizations, State Organizations, and Audubon Societies.

1902. Palmer, T. S. Protection of Game. New York State Library Bulletin, No. 72, March, 1902, pages 198-204.

A review of legislation of 1901 for the protection of game.

1902. Palmer, T. S., and Olds, H. W. Game Laws for 1902. A Summary of the Provisions relating to the Seasons, Shipment, Sale, and Licenses. United States Department of Agriculture, Farmers' Bulletin No. 160, pages 1-56.

"Intended as a guide to existing regulations, State and Federal, which govern the trade in game."

1902. Sandys, Edwyn, and Vandyke, G. S. Upland Game Birds. New York: The Macmillan Company, pages i.-xii., 1-429.

One of the best of recent books treating of game birds.

1902. Tout, Wilson. Ornithology in the Schools. National Committee of the Audubon Societies. Leaflet No. 2, June, 1902. 4 pages.

An excellent discussion of "the how and when of bird study" in the schools.

1902. Wheelock, Irene Grosvenor. Nestlings of Forest and Marsh. Chicago: A. C. McClurg & Co., pages 1-257.

An admirable book containing many original observations as to feeding habits. Excellent illustrations from photographs from life.

1903. Palmer, T. S. The Cold Storage of Game. Proceedings of the Twelfth Annual Meeting American Warehousemen's Association, pages 176-185. Reprinted in *Forest and Stream,* vol. lx., pages 210-211.

An important discussion, with these sub-titles: Refrigeration and Game Protection; Legal Status of Game; Important Storage Cases; Bonding Game.

FOREIGN BOOKS.

Oustalet, Emile. La Protection des Oiseaux. Paris: Jouvet et Cie. (No date.) Pages 1-117.

An illustrated discussion of the economic relations of the birds of France.

1887. Wood, Theodore. Our Bird Allies. London. Society for Promoting Christian Knowledge. Pages i.-x., 1-214.

A general discussion of the economic relations of British birds.

1888. Barggreve, Bernard. Die Vogelschutzfrage. Leipzig: Hugo Voigt. Second edition (First, 1878). Pages 1-173.

A discussion of European conditions.

1893. Watson, John (editor). Ornithology in Relation to Agriculture and Horticulture. London: W. H. Allen & Co. Pages i.-vii., 1-220.

Essays by various English authorities upon the economic relations of British birds.

1897. Masefield, John R. B. Wild Bird Protection and Nesting Boxes. Leeds, England: Taylor Brothers. Pages 1-129.

A discussion in four parts with these titles: Wild Bird Protection; Mediæval Bird Laws; Bird Nesting Boxes; Wild Birds Protection Acts. Many good illustrations.

1901. Hudson, W. H. Birds and Man. London and New York: Longmans, Green & Co., pages 1-317.

Delightful essays, though not dealing especially with economic relations.

INDEX

A.

Acadian owl, 201
Acridiidæ, 43
Alice's thrush, 104
American eider, 242
American goldfinch, 133
American redstart, 117
American snipe, 231
American warblers, 113
American white-fronted goose, 244
American woodcock, 229
Ampelidæ, 125
Animal food of birds, 42
Aphididæ, 45
Army-worm, 49
Auks, 250

B.

Baltimore oriole, 156
Bandtailed pigeon, 222
Bank-swallow, 129
Barn-owl, 196
Barn-swallow, 128
Barred owl, 197
Bay-winged bunting, 134
Bibliography, 326
Bird-baths, 309
Bird-day, 270
Bird-houses, 310
Bird-protection, discussion of, 268
Birds as regulators of outbreaks of injurious animals, 69
Bittern, 237
Black and white creeping warbler, 114
Black-billed cuckoo, 193
Blackbirds, 157
Black-capped titmouse, 107
Black duck, 239
Black rail, 234
Black skimmer, 249
Black snow-bird, 138
Black-throated green warbler, 117
Black vulture, 215
Bluebird, 86
Blue-jay, 171
Blue yellow-backed warbler, 114
Bobolink, 163
Bob-white, 222
Bohemian waxwing, 125
Bombycidæ, 50
Bonaparte's rosy gull, 248
Braconidæ, 56
Brant goose, 244
Broad-winged hawk, 206
Bronzed grackle, 158
Brown creeper, 109
Brown gannet, 245
Brown pelican, 246
Brown thrush, 101
Buds and blossoms, 40
Bull-bat, 179
Burrowing owl, 203
Butcher-birds, 122
Butter-ball, 242
Butterflies, 51
Buzzards, 215

C.

California partridge, 227
Canada goose, 244
Canada nuthatch, 107
Canvas-back duck, 241
Caprimulgidæ, 178
Carabidæ, 52
Carolina dove, 222

Carolina rail, 234
Carolina titmouse, 110
Carrion crow, 215
Cat-bird, 99
Cathartidæ, 218
Cecropia moth, 184
Cedar-bird, 125
Cedar waxwing, 125
Certhiidæ, 109
Chaparral cock, 194
Cherry-bird, 124
Chewink, 141
Chickadee, 107
Chimney-swallow, 177
Chimney-swift, 177
Chinch-bug, 44
Chipping-sparrow, 137
Chrysomelidæ, 53
Cicindelidæ, 52
Clapper rail, 234
Coccinellidæ, 53
Coleoptera, 51
Columbia fasciata, 222
Columbian sharp-tailed grouse, 227
Common crow, 167
Common puffin, 250
Conservation of birds, 255
Cooper's hawk, 211
Coot, 235
Cormorants, 246
Cow-bird, 162
Cranes, 235
Creepers, 109
Crow blackbird, 158
Crows, 167, 215
Cuckoos, 192
Curculionidæ, 54
Curlews, 232
Cypselidæ, 177

D.

Dabchick, 254
Darter, 245
Development of economic ornithology, 17
Dickcissel, 140
Dipper, 242
Diptera, 51
Double-crested cormorant, 246
Dowitcher, 231
Downy woodpecker, 184
Duck-hawk, 212
Ducks, 239
Dusky duck, 239
Dusky grouse, 227

E.

Eagles, 213
Eared grebe, 254
Economic ornithology, 17
Egg-collecting, 257
Egret, great white, 237
Elateridæ, 53
Elf-owl, 201
Encouraging the presence of birds, 304
English sparrow, 144
Eskimo curlew, 233
Evening grosbeak, 132

F.

Field-sparrow, 136
Finches, 132
Fish-ducks, 243
Fish-hawk, 212
Florida gallinule, 235
Flycatchers, 174
Food, amount of, consumed by birds, 60
Food of birds, methods of studying, 9
Food, smaller birds for, 262
Formicidæ, 55
Forster's tern, 248
Frigate bird, 247
Fringillidæ, 132

G.

Gallinules, 235
Game-birds, 272

Gannets, 244
Geese, 239
Geometridæ, 49
Goatsuckers, 178
Golden-crowned kinglet, 104
Golden eagle, 214
Golden-eye, 242
Golden plover, 229
Golden robin, 156
Goosander, 243
Goshawk, 212
Grass-finch, 134
Gray snipe, 231
Great black-backed gull, 247
Great blue heron, 237
Great crested flycatcher, 176
Greater scaup, 242
Greater yellow-legs, 232
Great heron, 237
Great horned owl, 201
Great northern shrike, 123
Grebes, 253, 254
Greenlets, 120
Grouse, 222, 224
Gryllidæ, 43
Guillemots, 251
Gulls, 247

H.

Hair-bird, 137
Hairy woodpecker, 182
Hawks, 205
Hemiptera, 44
Hermit thrush, 104
Herons, 236
Hirundinidæ, 127
Homoptera, 44
House-wren, 110
Hudsonian curlew, 233
Hudsonian godwit, 231
Humming-birds, 177
Hymenoptera, 55

I.

Ibises, 236
Ichneumonidæ, 56
Insects eaten by birds, 42
Ivory-billed woodpecker, 181

J.

Jaegers, 249
Jassidæ, 44
Jays, 157
Junco, 138

K.

Killdeer plover, 229
Kingbird, 175
King eider, 242
Kingfisher, 191
Kinglets, 104
King rail, 234
Kites, 214
Kittiwake gull, 248

L.

Lacey bird law, 320
Laniidæ, 122
Law, bird, of the American Ornithologists' Union, 317
Laws, bird, some fundamental principles of, 323
Laws, federal, 323, 324
Laws not uniform, 282
Laws, State, 323, 324
Laws, uniform, 285
Leaf-miners, 49
Least flycatcher, 176
Lepidoptera, 46
Lesser scaup, 242
Light-houses, destruction of birds by, 257
Locustidæ, 43
Loggerhead shrike, 123
Long-billed curlew, 232
Long-eared owl, 200
Long-tailed chickadee, 110
Loons, 253, 254
Luna moth, 180

M.

Magpie, 171
Mallard duck, 239
Man-of-war bird, 247
Marbled godwit, 231
Marsh-harrier, 212
Marsh-hawk, 212
Marsh-wren, 112
Maryland yellow-throat, 118
Meadow-lark, 165
Mergansers, 243
Methods of studying food of birds, 9
Mexican cormorant, 246
Millinery purposes, birds sacrificed for, 259
Mniotiltidæ, 112
Mocking-bird, 103
Mountain partridge, 227
Mourning-dove, 222
Myriapoda, 58
Myrtle-bird, 115

N.

Nashville warbler, 114
Nest-destroying, 257
New England jackdaw, 160
Night-hawk, 178
Night-jars, 178
Noctuidæ, 49
Non-game birds, 255
Northern phalarope, 233
Nuthatches, 105

O.

Old squaw, 242
Orioles, 156
Orthoptera, 42
Osprey, 212
Owls, 195

P.

Partridge, 222
Pelicans, 246
Petrels, 250
Pewee, 174
Phalangiidæ, 58
Phalaropes, 233
Phœbe, 174
Picidæ, 181
Pied-billed grebe, 254
Pigeons, 219
Pileated woodpecker, 181
Pine grosbeak, 132
Plovers, 228
Porzana, 234
Prairie-hen, 226
Predaceous animals, 257
Puffin, 250
Purple finch, 133
Purple gallinule, 235
Purple grackle, 158
Purple martin, 129

Q.

Quail, 222

R.

Rails, 233
Rallus, 234
Red-breasted merganser, 243
Red-breasted nuthatch, 107
Red-eyed vireo, 119
Red-head duck, 241
Red-necked grebe, 254
Red phalarope, 233
Red-shouldered hawk, 207
Redstart, 117
Red-tailed hawk, 208
Red-winged blackbird, 161
Relations of birds to man, 1
Rhyncophora, 54
Richardson's grouse, 227
Ring-neck duck, 241
Ring-neck plover, 228
Roadrunner, 194
Robin, 90
Rose-breasted grosbeak, 141
Rose tanager, 131
Rough-legged hawk, 207
Ruby-crowned kinglet, 105
Ruby-throat, 177

Ruddy duck, 242
Ruffed grouse, 224

S.

Sand-hill crane, 236
Sap relished by birds, 41
Sapsucker, 189
Savanna-sparrow, 137
Saw-whet owl, 201
Scarabeidæ, 54
Scarlet tanager, 131
Scoters, 242
Screech-owl, 199
Sea parrot, 250
Sharp-shinned hawk, 210
Sheldrake, 243
Shining fly-snapper, 124
Shore-birds, 219
Short-eared owl, 197
Shrikes, 122
Sickle-bill, 232
Sittinæ, 105
Snake-bird, 245
Snipes, 229
Snow-bird, 134
Snow-bunting, 134
Snow-goose, 244
Snowy owl, 203
Song-sparrow, 138
Sooty grouse, 227
Sparrow-hawk, 205
Sparrows, 132
Spiders, 57
Stake-drivers, 237
Storks, 236
Strigidæ, 196
Summer duck, 240
Summer red-bird, 131
Summer yellow-bird, 116
Surf-duck, 242
Swainson's hawk, 206
Swainson's thrush, 103
Swallows, 126
Swallow-tailed kite, 214
Swans, 239
Swifts, 174
Sylviidæ, 104

T.

Tanagers, 123
Tanagridæ, 131
Tarnished plant-bug, 44
Teals, 239
Tennessee warbler, 115
Terns, 248
Thistle-bird, 133
Thrasher, 101
Tipulidæ, 51
Titmice, 107
Tortricidæ, 48
Towhee bunting, 141
Townsend's fly-catching thrush, 125
Trapping, 267
Tree-sparrow, 135
Trochilidæ, 177
Troglodytidæ, 11
Trumpeter swan, 244
Turkey-buzzard, 215

U.

Upland plover, 232
Upland sandpiper, 232

V.

Vegetable food of birds, 27
Vesper sparrow, 134
Vireos, 119
Virginia rails, 234
Vultures, 215

W.

Warblers, 112
Warbling vireo, 121
Waxwings, 124
Whippoorwill, 178
Whistler, 242
Whistling swan, 244
White-bellied swallow, 129

White-breasted nuthatch, 106
White-crowned sparrow, 136
White egret, 237
White-eyed vireo, 121
White gannet, 245
White ibis, 236
White pelican, 246
White-throated sparrow, 136
Whooping crane, 235
Wild goose, 244
Willet, 231
Wilson's phalarope, 233
Wilson's snipe, 231
Wood-duck, 240
Wood ibis, 236
Woodpeckers, 181
Wood pewee, 176
Wood stork, 236
Wood thrush, 103
Wood warblers, 112
Wrens, 110

Y.

Yellow-billed cuckoo, 193
Yellow crake, 234
Yellow-rumped warbler, 115
Yellow-throated vireo, 121
Yellow warbler, 116

THE END.

2

8.2
B96

DO NOT REMOVE THIS CARD FROM BOOK POCKET. A FEE OF $1.00 WILL BE CHARGED FOR LOSS OR MUTILATION

UNIVERSITY OF ARIZONA
LIBRARY

SIGILLVM VNIVERSITATIS ARIZONENSIS
ESTABLISHED 1885

THEIR RELATIONS TO

68-1